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N.W. BERNSTEIN & ASSOCIATES

2000 M STREET, N.W., SUITE 745 • WASHINGTON, D.C. 20036 • (202) 466-8100 • FAX: (202) 466-8877

July 31, 1995

Mike McAteer
United States Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604

Re: Background Material Related to the Enviro-Chem Site

Dear Mr. McAteer:

By way of background, please find enclosed two letters dated September 25, 1992, and April 30, 1993, related to access problems that the Trustees have encountered since the beginning of this matter. Also enclosed is a copy of the Indiana Department of Environmental Management "Calculation of Tier II Cleanup Goals Based on Human Health Evaluation, revised February 1, 1994".

Very truly yours,

Norman W. Bernstein, Trustee

Enclosures

cc: Tony Likins, IDEM

BARNES & THORNBURG

April 30, 1993

VIA FACSIMILE AND U.S. MAIL

Ms. Karen Vendl
Remedial Project Manager
U.S. Environmental Protection Agency
Region V
77 West Jackson Blvd.
Chicago, Illinois 60604

Re: Enviro-Chem Superfund Site: Update on Force Majeure Notice Regarding Access

Dear Karen:

As you requested at our April 16, 1993 Enviro-Chem meeting in Chicago, this letter provides an update on the Enviro-Chem Trustees' force majeure notice regarding the Trustees' inability to secure a written agreement for access to the Enviro-Chem site and adjacent property necessary to implement the September 10, 1991 Enviro-Chem Consent Decree. Attachment 1 lists the prior correspondence and meetings with the government regarding this issue. As you can see, copies of this letter have been sent to all the parties listed in Section XXII of the Consent Decree.

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As mentioned in our September 25, 1992 update letter on this subject, we held a meeting with the Bankerts' lawyers (Messrs. Kunz and Zubek) on August 21, 1992 to discuss our proposed settlement agreement and easement which had been provided to them on July 1, 1992. As you may recall, the Bankerts' lawyers told us at that meeting that we needed to send them clean copies of the July 1 package so they could mark them up to move the process forward. The requested "clean copies" were provided August 27, along with an oral response to all questions they raised at our August 21 meeting. Despite the passage of over nine months, we still have never received any mark-up of or comments to the July 1, 1992 settlement package.

In October 1992, it became apparent that little progress was being made with the Bankerts' lawyers, and everyone agreed that the Trustees' technical representatives should meet directly with the Bankerts and their consultant to try to negotiate an agreement on the area needed to perform the remedy, which we have coined the "footprint". At that time, the Trustees also instructed AWD to reevaluate our entire approach to the footprint to see if a technical alternative could be developed to avoid

continuing conflicts with the Bankerts while still assuring that the work will get done.

By October 15, 1992, AWD had developed four different footprint approaches, each providing different configurations for essential support zone activities including such things as decontamination facilities, construction and government-oversight trailers, a water management pad, material laydown areas, and traffic patterns, to and from, and within, the footprint. On October 30, 1992, and after receiving the Trustees' input on these approaches, Brad Grow and I spent at least two hours at the Bankerts' offices with Bob and Greg Bankert and their consultant, Terry West, discussing the different approaches and incorporating the Bankerts' reactions and revisions. We left copies of the drawings with the Bankerts for their further review.

After additional follow-up discussions with the Bankerts, AWD prepared a new proposal dated November 11, 1992, and submitted it to the Bankerts. The Trustees also arranged for Schneider Engineering to conduct a staked survey of the latest footprint so the Bankerts could see the geographic extent of the footprint in the field. The staked survey was completed on November 24, 1992, the same day representatives of AWD and the Bankerts met again to discuss the latest footprint. The attendees (AWD's Grow, Mark Dowiak, and Jackie Powers, and Bob and Greg Bankert) discussed the new footprint in the Bankerts' office and then spent three hours in the field reviewing the staked survey. The Bankerts marked-up the latest footprint drawing at the meeting to delineate what they would accept. AWD then went back to its office, redrew the footprint to the Bankerts' specifications, and sent it (the <u>seventh</u> revision performed for and submitted to the Bankerts) to Bob Bankert on December 17, 1992.

On January 7, 1993, while overseeing the Phase II Supplemental Investigation, Brad Grow, once again, met with Bob and Greg Bankert to discuss the December 17 drawing. After spending about an hour in the field, Mr. Grow was called away to attend other matters in connection with the supplemental investigation. When he returned less than an hour later, Greg Bankert was unavailable. The Bankerts' claim (in Mr. Kunz' April 14 letter) that Mr. Grow "abruptly left the site" is ridiculous.

In mid- to late-January 1993, Bob Bankert called Brad Grow to ask that the latest footprint be resurveyed in the field to

reflect the December 17 drawing. That staked survey was completed on January 25, 1993. On that date, Mr. Grow again met with Bob and Greg Bankert (Terry West participated by telephone) for several hours and walked the site to view the latest staked survey. Mr. Grow re-emphasized the critical importance of reaching closure on the footprint issue. At that meeting, the Bankerts and Terry West indicated the footprint was acceptable and could "serve as the nucleus" for an overall global agreement with the Bankerts.

When we learned the footprint issue had apparently been resolved, the Trustees re-focused their attention on resolving the "other issues" Terry West obliquely referenced in the January 25 meeting. On February 17, 1993, I sent a letter to Mr. Kunz, informing him that it appeared an agreement on the footprint had been reached and reminding him that despite the passage of several months, we had received absolutely no mark-up of, or comments on, the settlement papers hand-delivered to him originally on July 1 and again on August 27, 1992. I further indicated that we were trying to develop a new, more simplified access proposal, which would be delivered to him in the next few weeks, and specifically solicited from Mr. Kunz any thoughts, issues or comments that should be incorporated into this new settlement approach.

By letter dated February 25 (but not received until March 1), Mr. Kunz responded to my February 17 letter, and made the incredible suggestion that the footprint changes were evidently being made due to the Trustees' change of consultant. By letter dated March 10, I corrected Mr. Kunz' suggestion and reminded him that the footprint changes had absolutely nothing to do with our change of consultants, but rather were an effort to accommodate his clients. I also reiterated our understanding that a technical agreement on the footprint had been reached. Finally, I pointed out that although Mr. Kunz had said we would receive legal comments from him by the end of the first week of March, that had, unfortunately, not occurred.

By late March 1993, we still had heard nothing from Mr. Kunz. Rather than wait for his comments, we sent him a new settlement proposal dated March 26, 1993. That proposal, copies of which are enclosed, tried to substantially simplify the prior settlement package, abandoned the easement concept (to which the Bankerts had objected), and explained that if an agreement was not reached, action might have to be taken against the children of Jon and Patricia Bankert (the "Bankert beneficiaries") and

Boone County Resource Recovery Systems, Inc. We requested a response by April 15.

Mr. Kunz' April 14 response is enclosed. One of the most disturbing revelations in Mr. Kunz' letter is his statement that Bankerts still object to the footprint. This was the first we had heard since January 25, 1993, that any problems remained with respect to the footprint, despite the contrary representations made on January 25 by the Bankerts and Terry West, and despite the fact that our February 17 and March 10 letters specifically stated our understanding that an agreement on the footprint had been reached.

By letter dated April 30, 1993 (copy enclosed), we responded to Mr. Kunz' April 14 letter. As you can see, we have, again, acceded to the Bankerts' request and have agreed to one last site visit to see if the remaining footprint issues can be resolved once and for all.

Karen, given the schedules agreed to at our April 16 meeting, we are simply running out of time. It appears doubtful an agreement will be reached. Obviously, we cannot accept changes that would prevent implementation of the Consent Decree. We will keep you apprised of the results of our next meeting, but fear that other measures will be necessary.

To summarize, since September 25, 1992, the Trustees' representatives have held seven meetings with the Bankerts and/or their counsel, four of which were dedicated solely to the footprint issue; have developed seven separate footprint proposals for the Bankerts (in addition to four additional revisions that were rejected in-house as impracticable); have had staked surveys performed twice to show the footprint layout in the field; have conferred, by telephone, with the Bankerts or their representatives on at least six different occasions, again solely to discuss the footprint; and have spent in excess of $30,000 redesigning the remedy to try to accommodate the Bankerts' concerns. It is obvious the Bankerts are in absolutely no hurry to reach an agreement, and have (as with Northside) frustrated and stonewalled our efforts.

As discussed at our April 16 meeting, the Trustees plan to commence site preparation and material removal work in early August 1993. We will aggressively continue our last ditch efforts to reach an agreement with the Bankerts. If the Consent Decree is to be implemented, the Trustees, EPA and the Department

of Justice must work together to assure access. By this letter, we specifically request the assistance of the Department of Justice in obtaining access to the site so the Consent Decree can be implemented.

Sincerely,

John M. Kyle III

JMK:kkm
Enclosures
cc: Tom Krueger, Esq.
Barbara Rogers, Esq.
Jim Smith, Esq.
Director, EPA Region V, Waste Management Division
Commissioner, Indiana Department of Environmental Management

JMK01461

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BARNES & THORNBURG

1313 Merchants Bank Building
11 South Meridian Street
Indianapolis, Indiana 46204
(317) 236-1313

TWX 810-341-3427 B&T LAW IPLS
Telecopier (317) 237-1126

September 25, 1992

VIA FEDERAL EXPRESS

Thomas J. Krueger, Esquire
Assistant Regional Counsel
United States Environmental
Protection Agency, Region V
77 West Jackson Boulevard
Chicago, Illinois 60604

Ms. Karen A. Vendl
Senior Remedial Project Manager
Office of Superfund
United States Environmental
Protection Agency, Region V
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

COPY

Re: Access to the Enviro-Chem Site

Dear Tom and Karen:

This letter is written on behalf of the Enviro-Chem Trustees. Over the past 12 months or so, the Enviro-Chem Trustees and their counsel have attempted, as set forth below, to obtain access to the Enviro-Chem Site and immediately adjacent property that is necessary for the construction of the consent decree remedy. The efforts to date have been futile.

The Enviro-Chem Site is land locked, and the property surrounding the Site has been carved into small pieces which were transferred by Jonathan Bankert, Sr. (the incorporator, initial President, and majority stockholder of Enviro-Chem) to his children (the "Bankert Children") and their corporations. Ownership of the property that Jon Bankert believed encompassed the Enviro-Chem and Northside Superfund sites was retained by Jon Bankert and/or his wife, Patricia. As a result of these transfers, the Bankert Children now own land necessary to implement the Enviro-Chem remedy. Unfortunately, the Bankert Children, their corporations, and their counsel have continually thwarted any progress or access and have engaged in conduct that can only be labeled unreasonable and obstructionist. The chronology contained in this letter is supported by documentation which we would be happy to provide you upon request.

History of Access Negotiations

The Consent Decree was entered on September 10, 1991. Pursuant to Section X of the Decree, the Trustees were required to use their best efforts to obtain access to the site. In September and October, I informed Hal Kunz, the Bankerts' counsel, numerous times by telephone, by letter, and in person of the need to obtain an access agreement. In these discussions, I offered to prepare an easement which would provide access to the Site modeled after the Northside Sanitary Landfill Superfund Site easement which was negotiated with the same parties. This proposed easement was delivered to the Bankerts in October 1991.

On October 31, November 4, and November 6, we reminded Mr. Kunz in writing of the fact that we were to use our best efforts to obtain an access agreement within sixty (60) days of the entry of the Decree, and that we needed his response. In addition to the written correspondence, we attempted to reach Mr. Kunz during this period by telephone no less than three times. Our only successful call was on November 4th in which Mr. Kunz promised a response before the approaching deadline. However, Mr. Kunz did not respond to any other phone calls or letters until November 27th.

Finally, on November 27th -- 3 weeks after the deadline -- the Trustees received the only substantive response from Mr. Kunz regarding the proposed easement. Mr. Kunz refused to discuss the access issue alone, and insisted that the access agreement be part of an overall global settlement of all claims against the Bankerts including various PRPs' cross-claims against the Bankerts.[1] Mr. Kunz also questioned the accuracy of the legal descriptions of the Site we had provided and demanded that we rely on a drawing of the Site he had prepared which he felt sufficient to accomplish the remedy. Unfortunately, his drawing covered only a portion of the Enviro-Chem Site. This was the first time these issues had been raised.

During the next several months the parties corresponded regarding the terms of this global settlement and the specific area encompassed by the access agreement. The Bankerts demanded that the global settlement incorporate provisions regarding access roads, reversions of property interests after portions of the remedy had been completed, use of clay

[1]The PRPs' cross-claims against the Bankerts have been asserted in the case United States of America v. Environmental Conservation and Chemical Corporation, Cause No. IP83-1419-C.

material from Parcels 35 and 39, fencing, cooperative uses of the real estate, and various other provisions relating to settlement of the claims and cross-claims against the Bankerts.

The Bankerts' request for a global settlement substantially complicated matters. Not only did we have to obtain the approval of the access issues from the Trustees, but we also had to formulate a settlement of the cross-claim, and communicate the proposed terms to, and obtain the approval of, the Enviro-Chem Litigation Committee, which is in charge of our cross-claims against the Bankerts.

On March 6, 1992, and after obtaining the approval of the Enviro-Chem Trustees and the Litigation Committee, I met with Hal Kunz and Warren Krebs to present a nine point global settlement plan. The plan provided for, *inter alia*, settlement of all cross-claims, access to the Site, and a Grant of Easement for the remedy. The entire purpose of the meeting was to outline our basic settlement terms so the Bankerts' counsel could discuss these points with their clients and provide some preliminary reactions. Mr. Kunz specifically agreed that this format would speed up the process, and I could incorporate his clients' reactions before actually drafting the papers.

More than a week after this meeting, I received a phone call from Hal Kunz asking me to put the nine point proposal in a letter because he did not recall the specific terms and wanted them in writing to discuss with his client. In addition, Mr. Kunz raised an issue regarding utilization of property owned by the Bankert Children that lies immediately west of the Enviro-Chem Site ("Parcel 45") (see attached map). The Bankerts' lawyers contend that the children received this parcel from their parents in 1984 and have no obligation to provide access over and around that parcel nor to permit its use in the construction of the remedy since it was severed from the Enviro-Chem Site. The Bankerts' lawyers also demanded that Barnes & Thornburg revise the Site remedy map, submitted as part of the revised plans and specs and tendered to EPA, to show the location of the existing fence around the Enviro-Chem Site so they could better determine the extent of the remedy's encroachment of Parcel 45. We complied with these demands and on March 27, 1992, sent a formal letter to Hal Kunz explaining the details of the nine point global settlement. On March 31st, Don Williams and I met with Hal Kunz and Greg Zubek to discuss the Bankerts' reactions to the nine point settlement proposal and the remedy map. The Bankerts' lawyers again challenged the use of adjacent property in the construction and implementation of the remedy, as well as the number and location of construction and decontamination facilities and remedy components.

During the entire month of April, we intensified our efforts to obtain access. During this period, Barnes & Thornburg engaged in extensive efforts to meet with and resolve problems raised by the Bankerts in regard to minimization of the impact of the remedy on adjoining property and provided all technical documentation and settlement documentation demanded by the Bankerts. During this time, we transmitted several maps to the Bankerts' counsel describing the Site, and held numerous conversations answering their questions.

On April 16 we received the design maps back with hand drawings on them made by the Bankert Children and their counsel. These suggested revisions appeared to have been made without any reliance on or consultation with technical people familiar with Superfund remedies in general, or the Enviro-Chem remedy in particular. Rather, the Bankerts penciled in new buffer lines, redrew the decontamination, construction, and EPA oversight trailers in the middle of roadways and moved fence lines. They demanded these changes be made. Moreover, the modifications were made without technical advice or consultation with health and safety regulations or OSHA standards. The simplistic, modified drawings were, quite simply, incompatible with the remedy for the Site.

The Trustees, in good faith decided to have engineers and consultants review the changes to determine if and how they could be incorporated into the final remedy design. David Hurst from ERM-North Central and two attorneys from Barnes & Thornburg met with Hal Kunz and Terry West at the Site on April 21, to discuss these proposed modifications in an effort to resolve these issues. At that meeting, it was obvious that Mr. Kunz and Dr. West were not prepared and had not studied the design drawings in sufficient detail prior to the meeting because objections were continually raised with regard to the size of the buffer zone and easement area without having made any comparison of that area to the cap contour drawings and design specs submitted to EPA. Mr. Kunz and Dr. West showed a continued intransigence in providing room to effectuate the remedy including requesting us to violate OSHA standards in the placement of trailers and their refusal to give us an easement for grading and drainage of the cap. In addition, the Bankerts continued to assert that the proposed remedy infringed unreasonably and illegally upon Parcel 45.

We again commenced review of the design drawings in an attempt to meet the concerns of the Bankerts regarding the Site layout raised in the April 21st meeting. The work included working with our engineers and reaching a compromise on the issue of the Bankerts' ability to traverse a drainage swale, movement of structures and equipment to further minimize the impact of the remedy on the adjoining parcel, and phone calls with U.S. EPA to assess the impact of changes to the Site layout on EPA's decision to approve

the design drawings already submitted. Furthermore, the Trustees met several times to discuss issues related to access and approve any modifications to the design drawings.

During the last several months, and in an effort to obtain a global settlement with the Bankerts, we drafted a fifteen page Settlement Agreement and a six page Grant of Easement. These documents were transmitted to Hal Kunz on May 4th. In addition, we continued to work with consultants to obtain all legal surveys and descriptions required as exhibits to the agreement as well as with the Boone County Abstract Company to obtain title policies on all properties involved at the Site. The tasks involved are and were complex because of the Bankerts' unsystematic, haphazard dissection of the properties involved and the interlocking and constantly changing corporate entities holding title to or leasing the property.

On May 8th, Don Williams contacted Mr. Kunz by telephone to set up a time to meet to discuss the Settlement Agreement and Grant of Easement which they received on May 4th. Mr. Kunz indicated that he did not want to be bothered with our phone calls and refused to meet to discuss the Settlement Agreement and Grant of Easement until he received every single exhibit to the Settlement Agreement, including all legal descriptions and surveys, conferred with his client and his consultants, and had responded in writing. Only then would he contemplate meeting to discuss the provisions. At that point, Mr. Williams indicated that the exhibits (mostly legal descriptions of parcels and easements) were not essential to the preliminary discussion of the issues and that the negotiating could begin as the Settlement Agreement and Grant of Easement were extremely inclusive. Moreover, any discussion would, of course, be subject to a complete review of the exhibits when they were completed. Nevertheless, Mr. Kunz again refused to meet. We sent an additional letter on May 12th indicating our desire to meet and requesting a meeting time and date. Mr. Kunz responded in writing on May 15 indicating that from now on it was their intent to conduct negotiations in writing only, and that during these negotiations they did not intend to revisit or discuss any issue that they decide is unacceptable.

On June 5, 1992, John Kyle sent a revised version of the Settlement Agreement and Grant of Easement to Hal Kunz. The June 5th version included all attachments (the legal descriptions and a site map). The June 5th version included minor changes to the language of the May version of the Agreement, most of which were prompted by changes to accommodate the Bankerts' concerns regarding property uses adjoining the Site. The Agreement contained redlining and strike-outs so that all revisions were readily apparent. No response was received despite our request to meet to discuss the provisions and terms contained in the Agreement.

During the week of June 5, we also discovered that the Bankerts had submitted to the Boone County Planning Commission formal plans to develop yet another new resource recovery facility in an area to be occupied by the remedy as well as a portion of land adjacent thereto. We immediately contacted our design people to assess the potential impact of the construction of this building on the remedy and contacted the Bankerts to request that they not proceed with any construction until we had determined the impact of this construction activity. The Bankerts indicated that they were well aware that the building encroached upon the proposed remedy, but indicated that the land was theirs to use as they pleased, and they were permitted to construct the building on their land regardless of its impact on the remedy. This issue still has not been resolved.[2]

During the month of June we continued to modify some of the language of the Settlement Agreement and drafted a simplified Grant of Easement containing essentially the same terms as the prior Grant of the Easement in the hope that it would be better understood. This version was sent to Mr. Kunz on July 1, 1992. Again, we received no response. On July 23, I sent another letter requesting to meet. Finally Hal Kunz and Greg Zubek agreed to meet, and on August 21, 1992 I met with them to discuss the issues of settlement. At that meeting, the Bankerts again asked the same questions that they had asked before, most of which were resolved by and covered in the provisions of the Settlement Agreement and Grant of Easement. It was clear that they, once again, had not studied the documents or my cover letter in sufficient detail to conduct a meaningful discussion. They also had not made a clean copy of the documents and asked that I send them fresh copies so they could mark them up with their suggested changes. Several of their questions, however, were also addressed to the remedy components and required consultation with our design people. I told them we could call them with the answers to these questions.

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[2]It was not until September 9 of this year that the Trustees learned the true geographic extent of the Bankerts' new proposed facility. At that time, the Trustees were provided with a map containing a hand-drawn line by Bob Bankert that showed the transportation route into the new resource recovery facility. Rather than access the new building on the side opposite Enviro-Chem, the Bankerts have proposed to enter from the east, or Enviro-Chem, side of the building and have plans to build a "broad-swing" access road that lies even closer to the site than the proposed building. The Trustees have asked our consultant and engineers to review the Bankerts' newest planned use of the property. We will advise you as soon as we learn the scope and extent of the encroachment into the remedy and whether these structures can coexist with the remedy.

On Thursday, August 27, 1992, Don Williams called Mr. Greg Zubek with answers to the questions raised on August 21. Mr. Williams spoke with Mr. Zubek at length regarding the specific provisions of the Grant of Easement, the order of property reversions, the requirement of a buffer zone, and various issues related to the access roads. During that discussion Mr. Williams emphasized to Mr. Zubek the need to meet to discuss the terms and to reach settlement. On that date, Don Williams also sent Hal Kunz and Greg Zubek a clean copy of the Settlement Agreement and Grant of Easement to mark up and return to us. To date we have received no written response.

On September 1, 1992, Mr. Williams spoke with Hal Kunz, Bob Bankert, and Greg Bankert in a conference call regarding the very same questions raised by Greg Zubek in the previous meeting. Mr. Williams again painstakingly reviewed the provisions of the Grant of Easement and listened to their concerns regarding the Site map. At that meeting, the Bankerts again asserted their right to use Parcel 45 in any manner they wanted and were unhappy about our plan to use part of their property in the implementation of the remedy. Mr. Williams also expressed to Mr. Kunz repeatedly the need to meet to discuss the Settlement Agreement and to resolve the remaining issues. Mr. Kunz indicated that we had delayed in not contacting him to respond to the questions raised in the August 21st meeting. Mr. Williams informed him of the conversation with Greg Zubek of which he was completely unaware. Mr. Kunz said he would call and arrange a meeting the following week (after Labor Day) to discuss settlement. To date, we have received no such call.

On September 14, 1992, Mr. Williams sent Mr. Kunz another letter requesting to meet to discuss settlement noting that we had received no substantive response to the Settlement Agreement and Grant of Easement since they received it on May 4th. On September 21, 1992, we received a letter from Hal Kunz. The letter is another item in a growing list of confounding and inaccurate correspondence from the Bankerts. It references new uses of Parcel 45 which interfere with the implementation of the remedy. Moreover, Mr. Kunz states in his letter that we had promised an addendum to the Settlement Agreement and that they need to receive that addendum before they can meet to discuss the Site. However, the addendum is a technical memorandum drafted for a separate Superfund site (Northside) and is completely irrelevant to the Enviro-Chem Site. Finally, Mr. Kunz provided no opportunity to meet to discuss settlement. Our response to this latest correspondence is enclosed.

Ownership of the Site

Aside from the intransigence and delay which has occurred in trying to reach an access settlement, the most troubling aspect of negotiations has resulted from the Bankerts' and their counsels' assertion that we have no right to use land outside the area of defined contamination (defined by the Bankerts as the area described in the lease agreement under which the Enviro-Chem corporation operated at the Site). In particular they have refused to let us use Parcel 45 which is adjacent to and immediately west of the Site and which is absolutely essential to the implementation of the remedy.[3]

The basis for the Bankerts' refusal to allow us to use Parcel 45 is that in 1984, Parcel 45 was intentionally severed from the Enviro-Chem Site by Jon Bankert, Sr. and transferred to them. Parcel 45 is now not owned by the previous Superfund owner. As a result, the Bankert Children argue that they, as the new owners, have no obligation to provide access and space for the construction and implementation of the remedy. In essence they have argued that by their father's severance of the property, they have been released from all obligations to make property available for the remedy. They have also argued that any use of their property in constructing or effectuating the remedy is an infringement of their property rights. Their analysis is flawed for at least two reasons.

First, it is clear from the survey prepared in 1987 by CH_2M Hill, EPA's contractor for the Site, that the remedial site boundary extends into Parcel 45. We have established

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[3]As specified in our most recent design plans, the western portion of Parcel 45 and another Bankert parcel to the north is required to implement the remedy for several reasons, including the following:

- access for vehicles and equipment used to construct the remedy (as noted earlier the Site is landlocked);
- decontamination areas;
- construction/oversight trailers;
- support vehicles and trailers;
- staging of equipment and materials;
- construction of the cap, which will, of necessity, "spill over" the actual Site boundaries into Parcel 45 to achieve adequate slope;
- construction and maintenance of a drainage swale;
- construction, maintenance and sampling of monitoring wells; and
- areas to allow movement around the perimeter of the cap for maintenance and access to the SVE System.

through two independent surveyors that the Bankert Children actually own a portion of the Enviro-Chem Site. As a result, they are potentially responsible parties under CERCLA § 107(a)(1) as owners of a Superfund site and have a responsibility, at a minimum, to provide access to the Site to perform the remedy.

Second, the common law doctrine known as *lis pendens* provides that any party who acquires title to real estate, with actual or constructive notice of pending litigation involving that real estate, is bound by the judgment or decree issued in the pending litigation and takes title subject to the rights of the parties to that litigation. The effect is to make all successors in ownership abide by the outcome of a pending action as if they were the parties to the action. *Lis pendens* is applicable to situations such as the one at hand where a party severs a larger piece of property subject to litigation. In most instances, the new owner of the severed parcel is bound by the outcome in the litigation as if the parcel was never severed. Thus, the Bankerts' claim that they have no obligation to provide access to the Site because they do not own any of the Site (which clearly is not true) is unfounded. As shown below, they take subject to the pending litigation and are bound by its outcome.

For a party who takes title to property involved in pending litigation to be bound by that litigation, two requirements must be met. First, the pending action must involve title to property or an action to enforce any lien, right to, or interest in real property. An enforcement action of the type involved in the EPA's original suit in 1983 is just such an action. Second, for any judgment to bind subsequent purchasers or incumbrancers, they must have actual or constructive notice of the pending litigation affecting the property. The litigation in question was brought in 1983. The parties to that litigation include Jonathan and Patricia Bankert, the parents of the Bankert Children. The doctrine provides that subsequent purchasers have constructive notice of every fact contained in the pleadings or that is apparent from the face of the proceedings which is relevant to the issue or relief sought at the time of purchase and to all such facts that one would necessarily be on notice of if they inquired about and which inquiry would bring to one's knowledge. In 1984 when the Bankert Children took title to Parcel 45, the Bankert Children clearly were aware of the enforcement action and that a remedy would be required at the Site. Thus, they clearly had constructive notice and are bound to cooperate with the remedy required by that enforcement action. Severance of the properties did not release the Bankert Children from their obligations.

Despite the Trustees' best efforts, the Trust has been unable to secure a formal access agreement, although, by making calls prior to each visit, we have been able to get on the site to perform various studies and inspections. We may therefore be forced in the near

future to request that the U.S. EPA assist us in obtaining long-term access, including the condemnation of the Enviro-Chem Site and adjacent property pursuant to § 104(j) of CERCLA, 42 U.S.C. § 9604(j). As you know, § 104(j) authorizes EPA, on behalf of the President, to "acquire, by purchase, lease, condemnation, donation, or otherwise, any real property or any interest in real property that the President [or EPA in his behalf] determines is needed to conduct a remedial action . . . ". The Trustees are aware that the circumstances which demand such an action are uncommon. Nevertheless the situation at the Enviro-Chem Site and the conduct of the current landowners and their counsel may dictate such action.

We look forward to discussing these issues at our upcoming September 30th meeting in Chicago.

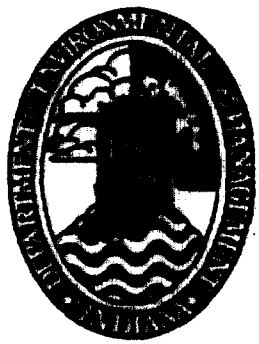
Sincerely,

John M. Kyle III

JMK:DEW:jjw:kkm
Enclosures
cc: As to the United States or U.S. EPA
Regional Counsel, U.S. EPA
Director, Waste Management Division
Assistant Attorney General

As to the State of Indiana
Attorney General
Commissioner, IDEM

Enviro-Chem Trustees



THE INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

CALCULATION OF TIER II CLEANUP GOALS BASED ON HUMAN HEALTH EVALUATION

Revised February 1, 1994

TIER II CLEANUP GOALS - HUMAN HEALTH EVALUATION

Cleanup goals for chemicals in source media for Tier II are calculated based on a human health evaluation using standard risk assessment assumptions. Cleanup goals are determined for one of two possible land use scenarios; non-residential or residential. The determination of whether cleanup goals based on a residential or non-residential scenario apply to a particular site depends on the environmental site setting (i.e., onsite and surrounding land use patterns) and projected future use. However, the use of cleanup goals to remediate a site based on an non-residential scenario will require some land use restrictions to prevent unrestricted future use of the site.

The methodology for calculation of Tier II, health-based cleanup goals was based on EPA's preliminary remediation goals (EPA, 1991), incorporating changes agreed upon by the Voluntary Remediation Program Technical Standards Subcommittee. The methodology for calculation of Tier II cleanup goals is provided in three parts. This first part presents background information and an overview of the health-based approach for determining preliminary remediation goals. Then detailed calculations are provided which outline the approach for calculating health-based goals specifically for the Tier II assessment. Finally, cleanup goals for selected compounds are presented that are applicable for remediation of sites with a Tier II assessment.

OVERVIEW OF EPA APPROACH FOR DETERMINING PRELIMINARY REMEDIATION GOALS

EPA has identified a standardized approach for calculating cleanup goals or preliminary remediation goals (PRGs) for the remedial investigation and feasibility study (RI/FS) process on federal Superfund sites. PRGs are equivalent in concept to Tier II cleanup goals such that they are health-based acceptable concentrations for chemicals of interest in a particular media. They are also derived independently for a site or sites without requiring a site-specific risk assessment (i.e., a Tier III risk assessment). The method for calculating these PRGs was outlined in the document *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual: Part B, Development of Risk-Based Preliminary Remediation Goals* (EPA, 9285.7-01B, December, 1991), an overview of which is discussed below.

EPA's approach for determining PRGS for a site include either applicable or relevant and appropriate requirements (ARARs) and/or health-based acceptable concentrations. This discussion, however, focuses only on the calculation of risk-based PRGs. Risk-based PRGs are calculated separately by chemical and media. The media evaluated in EPA Part B include soils and groundwater (and/or surface water used as a potable water source). However, for Tier II, soils were divided into two separate media based on their potential for exposure: surface soils and subsurface soils. Surface soils are defined as those soils within the top 2 feet of the surface that would be incidentally contacted by an industrial worker, while working, or by residents while playing (young children) and/or landscaping or gardening (adults). Subsurface soils were defined as soils below 2 feet that would only be contacted directly during excavation or construction activities. The potential for contact to subsurface or deeper soils would be less than for surface soils and would occur under different circumstances (i.e., excavation or

construction).

The development of risk-based PRGs begins with the determination of the probable future land use of the site and the potential receptor type that would apply. Potential exposure pathways are then identified using assumptions about the behavior and body parameters of the applicable receptor. For calculation of PRGs for each media, EPA identified applicable exposure pathways specific to the land use scenario evaluated. However, EPA only considered those exposure pathways that contribute significantly to the overall exposure and risk in the calculation of PRGs. Other relevant exposure pathways were assumed to contribute insignificantly to the overall exposure and were not included. Relevant exposure pathways were also assumed to vary according to residential and non-residential use scenarios. For the residential scenario, the exposure pathways considered applicable for groundwater were ingestion and inhalation of volatiles; and for soil was incidental ingestion. For the non-residential scenario, the exposure pathways considered applicable for determining PRGs for groundwater was ingestion; and for soil were incidental ingestion and inhalation of volatiles and fugitive dusts.

Once exposure pathways are identified, equations quantifying the health risk to the receptor can be developed. There are two general equations used in calculating potential human health effects in a risk assessment, one for carcinogenic effects, the other for noncarcinogenic effects. They are, for the carcinogenic assessment:

$$R_i = SF * I_i \quad (1)$$

where:
- R_i = excess lifetime cancer risk from exposure pathway *i*;
- SF = cancer slope factor $(mg/kg/day)^{-1}$;
- I_i = total chemical intake from exposure pathway *i* averaged over a lifetime (mg/kg/day)

and, for the noncarcinogenic assessment:

$$HI_i = \frac{I_i}{RfD} \quad (2)$$

where:
- HI_i = hazard index from exposure pathway *i*;
- I_i = average daily intake from exposure pathway *i* averaged over the period of exposure (mg/kg/day);
- RfD = reference dose (mg/kg/day).

Equations 1 and 2 are written in a general form in that chemical intake (I) varies according to exposure pathway and receptor. Total cancer risk and hazard index are then calculated by summing across all exposure pathways to give a total cancer risk (R_{tot}):

$$R_{tot} = \Sigma R_i \quad (3)$$

or total hazard index (HI_{tot}):

$$HI_{tot} = \Sigma HI_i \quad (4)$$

The equations quantifying the risk from a given chemical concentration in a particular medium can then be inverted to back-calculate a health-based acceptable chemical concentration, given an acceptable risk level. PRGs are then determined by using these equations with standard EPA default exposure factors, available toxicity data and appropriate target health effect levels. EPA designed the PRG methodology to be used initially to calculate PRGs for a site using strictly default parameters, and, at a later time, to be used with site-specific assumptions to update the PRGs. However, application of the PRGs concept for calculating Tier II cleanup goals assumes only the default parameters. Modification based on site-specific data, however, could be implemented as a part of a Tier III risk assessment.

Toxicity data refers to cancer slope factors (SFs) and reference doses (RfDs), collectively termed dose-response factors, used in Equations 1 and 2. Dose-response factors relate the intake or dose of a chemical to a carcinogenic effect or noncarcinogenic systemic effect from exposure to a contaminated medium. Dose-response factors are specific to a chemical and exposure pathway (i.e., oral versus inhalation). SFs and RfDs are obtained first from EPA's Integrated Risk Information System (IRIS), or if not available in IRIS, from EPA's Health Effects Assessment Summary Tables (HEAST).

Target health effect levels refer to the levels of cancer risks or hazard indices that are deemed acceptable by the EPA for a particular site. Target health effect levels are cancer risks and hazards indices below which the potential for effects to human health are assumed to be negligible or inconsequential. Generally, cancer risks are evaluated based on a range of acceptable risk from 1 in 10,000 (10^{-4}) to 1 in a 1,000,000 (10^{-6}). Noncarcinogenic effects are evaluated based on a hazard index of one or below which is generally deemed to be acceptable. The range of acceptable risk for the carcinogenic assessment reflects the range of uncertainty in the analysis and interpretation of the results for a particular site. This range also reflects the range of acceptability for various land uses. For federal Superfund sites investigated under the national contingency plan (NCP), sites with a cumulative total cancer risk level below 10^{-6} for all applicable receptors indicate no remedial action is needed. Whereas, for sites with cancer risk levels above 10^{-4}, some remedial action must be taken to mitigate potential cancer risks. For sites with maximum cancer risks in the range 10^{-4} to 10^{-6}, action is taken on a site-specific basis. Typically on sites with unrestricted future use (i.e., where residential use is possible), the target risk level is closer to 10^{-6}. However, on sites with restricted land uses for current and future non-residential purposes, target risk levels higher than 10^{-6} are often selected. Therefore, for determining health-based cleanup goals for carcinogens in the Tier II analysis, a "point of departure" for sites with unrestricted future use (i.e., including residential use) were based on a 10^{-6} target cancer risk level. For sites where current and future land use is restricted to non-residential purposes, the "point of departure" for carcinogens was the 10^{-5} target cancer risk level. The target hazard index used for evaluating noncarcinogenic compounds was 1, for

compounds that are not considered bioaccumulative, and 0.2, for compounds that are considered bioaccumulative. Table 1 of Water Quality Criteria for Specific Substances (Indiana Register, Volume 16, Number 7, April 1, 1993) was the basis for determining whether or not a compound was considered bioaccumulative.

CALCULATION OF HEALTH-BASED CLEANUP GOALS

Health-based cleanup goals were calculated for soils and groundwater according to EPA's PRG approach, with one exception. Cleanup goals for soils were developed separately for surface and subsurface soils since they differ in the potential for direct contact exposure. Cleanup goals for surface soils were based on EPA's PRG approach considering target receptors of either residents, for sites remediated for unrestricted future use, or industrial workers, for sites that are remediated for restricted land use for non-residential purposes. For subsurface or deep soils, applicable receptors are excavation workers (i.e., for utility placement or maintenance) or construction workers. These particular receptors would be exposed to subsurface soils at a higher rate (i.e., higher contact rate per day or event) than an non-residential worker or resident would be exposed to surface soils, but the exposure would occur over a shorter duration. The following paragraphs provide a discussion of calculating health-based criteria applicable for the non-residential and residential land use scenarios.

Non-Residential Land Use Scenario

Surface Soils: Potential exposure pathways considered applicable for surface soils in the non-residential scenario were incidental ingestion and inhalation of volatiles and fugitive dusts. The cancer risk, R, and hazard index, HI, for these exposure pathways by an industrial worker are calculated using equations written in the form of Equations 1 and 2, however they are expanded to consider specific formulas for calculating intake (I_i) as follows, for carcinogens:

$$R = \frac{EF \cdot ED \cdot C_s \cdot \left[\left(SF_o \cdot IR_{soil} \cdot 10^{-6}\ Kg/mg\right) + \left(SF_i \cdot IR_{air} \cdot (1/VF + 1/PEF)\right)\right]}{BW \cdot AT \cdot 365 days/yr} \quad (5)$$

and for noncarcinogens:

$$HI = \frac{EF \cdot ED \cdot C_s \cdot \left[\left(1/RfD_o \cdot IR_{soil} \cdot 10^{-6}\ Kg/mg\right) + \left(1/RfD_i \cdot IR_{air} \cdot (1/VF + 1/PEF)\right)\right]}{BW \cdot AT \cdot 365 days/yr} \quad (6)$$

The variables VF (soil to air volatilization factor) and PEF (particulate emissions factor) relate the exposure concentrations for the chemical in air to source concentration in soil. The values of VF and PEF are calculated according to the following equations:

$$VF\ (m^3/kg) = \left(\frac{LS \cdot V \cdot DH}{A}\right) \cdot \frac{(3.14 \cdot \alpha \cdot T)^{1/2}}{2 \cdot D_A \cdot E \cdot K_m \cdot 10^{-3} kg/g} \quad (7)$$

where:

$$\alpha\ (cm^2/s) = \frac{D * E}{E + \frac{\rho_s * (1-E)}{K_{as}}} \quad (8)$$

and

$$PEF\ (m^3/kg) = \left(\frac{LS * V * DH * 3600 s/h}{A}\right) * \left(\frac{1000 g/kg}{0.036 * (1-G) * (U_m/U_t)^3 * F(x)}\right) \quad (9)$$

The definitions of variables in Equations 5 through 9 and their EPA recommended default values are provided in Table 1. Equations 5 and 6 above provide numeric estimates of cancer risk (R) and noncarcinogenic hazard index (HI) as a function of the concentration of a chemical in soil. These equations can be inverted to solve for the soil concentration which becomes the health-based criteria (C_{goal}) for a particular compound, as follows:

$$C_{goal} = \frac{BW * TR * AT * 365 days/year}{EF * ED * \left(SF_o * 10^{-6} kg/mg * IR_{soil} + SF_i * IR_{air} * \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)} \quad (10)$$

and

$$C_{goal} = \frac{BW * THI * AT * 365 days/year}{EF * ED * \left((1/RfD_o) * 10^{-6} kg/mg * IR_{soil} + (1/RfD_i) * IR_{air} * \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)} \quad (11)$$

where: TR = target cancer risk level; and
THI = target hazard index.

The above expression allows for the explicit calculation of a soil health-based criteria once target cancer risk and hazard index levels are established.

Under the default assumptions presented in Table 1, and assuming a target cancer risk level (TR) of 10^{-5} and target hazard index (THI) of 1 for the non-residential scenario, the above two equations reduce to:

$$C_{goal} = \frac{2.9 * 10^{-3}}{\left(5 * 10^{-5} * SF_o\right) + \left(SF_i * \left(\frac{20}{VF} + 4.3 * 10^{-9}\right)\right)} \quad (12)$$

and

$$C_{gw} = \frac{102}{\left(5 * 10^{-5}/RfD_o\right) + \left(1/RfD_i * \left(\frac{20}{VF} - 4.3 * 10^{-9}\right)\right)} \quad (13)$$

Subsurface Soils: As with surface soils, potential exposure pathways applicable for a construction or excavation worker exposed to subsurface soils are incidental ingestion and inhalation of volatiles and fugitive dusts. The cancer risk and hazard index for construction workers were calculated and combined for these exposure pathways based on Equation 5 for carcinogens and Equation 6 for noncarcinogens. The parameter definitions for variables specific for construction workers exposed to subsurface soils are provided in Table 2. As with surface soils, health-based criteria (C_{gw}) for subsurface soils are calculated based on inverting Equations 5 and 6 and generating equations similar to 10 and 11.

Under the default assumptions presented in Table 2. and assuming a target cancer risk level (TR) of 10^{-5} and THI of 1 for construction workers in the non-residential scenario, Equations 10 and 11 reduce to:

$$C_{gw} = \frac{5.1 * 10^{-2}}{\left(1 * 10^{-4} * SF_o\right) + \left(SF_i * \left(\frac{20}{VF} - 4.3 * 10^{-9}\right)\right)} \quad (14)$$

and

$$C_{gw} = \frac{146}{\left(1 * 10^{-4}/RfD_o\right) + \left(1/RfD_i * \left(\frac{20}{VF} - 4.3 * 10^{-9}\right)\right)} \quad (15)$$

Groundwater: The exposure pathway considered applicable for groundwater in the non-residential land use scenario is ingestion. Cancer risks and hazard indices from this exposure pathway are calculated in equations that combine these intake assumptions as follows, for potential carcinogens:

$$R = \frac{EF * ED * C_w * SF_o * IR_w}{BW * AT * 365\ days/yr} \quad (16)$$

and, for noncarcinogens:

$$HI = \frac{EF \cdot ED \cdot C_w \cdot IR_w}{RfD_o \cdot BW \cdot AT \cdot 365\ days/yr} \quad (17)$$

The definitions of variables in Equations 16 and 17, and the EPA recommended default values are provided in Table 3. Equations 16 and 17 present health effects as a function of concentration of a chemical in groundwater. These equations can be inverted to solve for water concentrations or health-based criteria (C_{gwal}) for groundwater as follows:

$$C_{gwal} = \frac{TR \cdot BW \cdot AT \cdot 365\ days/yr}{EF \cdot ED \cdot SF_o \cdot IR_w} \quad (18)$$

and

$$C_{gwal} = \frac{THI \cdot RfD_o \cdot BW \cdot AT \cdot 365\ days/yr}{EF \cdot ED \cdot IR_w} \quad (19)$$

If the default assumptions presented in Table 3 are used and a target cancer risk of 10^{-5} and target hazard index of 1 are assumed, the above equations reduce to, for carcinogens:

$$C_{gwal} = \frac{2.86 \cdot 10^{-3}}{SF_o} \quad (20)$$

and, for noncarcinogens

$$C_{gwal} = 102.2 \cdot RfD_o \quad (21)$$

Residential Land Use Scenario

Surface Soils: The potential exposure pathway applicable for surface soils in the residential scenario was incidental ingestion. The equations of risk to a resident from soil ingestion are slightly different from the non-residential scenario as the ingestion rate is weighted to account for the change in body weight and ingestion rate as a resident child ages into a resident adult. The equations to be used to calculate risk and hazard index from soil ingestion under a residential scenario are:

$$R_{ing} = \frac{SF_o \cdot C_s \cdot 10^{-6}\ Kg/mg \cdot EF \cdot IF_{ing/soil}}{AT \cdot 365\ days/year} \quad (22)$$

and for noncarcinogens:

$$HI_{ing} = \frac{C_s \cdot 10^{-6}\ Kg/mg \cdot EF \cdot IF_{soil/adj}}{RfD_o \cdot AT \cdot 365\ days/year} \quad (23)$$

where $IF_{soil/adj}$ is the time-weighted average soil ingestion rate for residents divided body weight. Unlike the soil ingestion rate (IR_{soil}) used for a non-residential or construction worker, $IF_{soil/adj}$ is a parameter that accounts for the changing rate of soil intake as a child grows into a young adult in a residential setting. The variable $IF_{soil/adj}$ was calculated by the equation:

$$IF_{soil/adj}(mg-yr/Kg-day) = \frac{IR_{soil/age1-6} * ED_{age1-6}}{BW_{age1-6}} + \frac{IR_{soil/age\ 7-31} * ED_{age7-31}}{BW_{age7-31}} \quad (24)$$

The definitions of parameters in Equations 22, 23 and 24, and the EPA recommended default values are provided in Table 4. Equations 22 and 23 specify cancer risks and hazard indices as a function of soil concentration. These equations can be inverted to solve for soil concentrations or health-based criteria (C_{goal}) for surface soil as follows:

$$C_{goal} = \frac{TR \cdot AT \cdot 365 days/year}{SF_o \cdot 10^{-6} kg/mg \cdot EF \cdot IF_{soil/adj}} \quad (25)$$

and

$$C_{goal} = \frac{THI \cdot AT \cdot 365 days/year}{1/RfD_o \cdot 10^{-6} kg/mg \cdot EF \cdot IF_{soil/adj}} \quad (26)$$

where:
TR = target cancer risk level; and
THI = target allowable hazard index.

If the default assumptions presented in Table 4 are used and a target cancer risk of 10^{-6} and target hazard index of 1 are assumed, the above equations reduce to:

$$C_{goal} = \frac{0.64}{SF_o} \quad (27)$$

and

$$C_{goal} = 2.7 \cdot 10^{5}\ (RfD_o) \quad (28)$$

Subsurface Soils: As with subsurface soils in the non-residential scenario, subsurface soils in the residential scenario are assumed to only be contacted during excavation or construction activities. Therefore, the assumptions and equations determined for the non-residential scenario

would be applicable for the residential scenario. Thus, cleanup goals for subsurface soils in the residential scenario are the same as those determined for the non-residential scenario.

Groundwater: Potential exposure pathways considered applicable for groundwater in the residential land use scenario include ingestion and inhalation of volatiles. Cancer risks and hazard indices from these two exposure pathways are calculated in equations that combine these intake assumptions as follows, for potential carcinogens:

$$R = \frac{EF \cdot ED \cdot C_w \cdot [(SF_o \cdot IR_w) + (SF_i \cdot K \cdot IR_a)]}{BW \cdot AT \cdot 365\ days/yr} \quad (29)$$

and, for noncarcinogens:

$$HI = \frac{EF \cdot ED \cdot C_w \cdot [(1/RfD_o \cdot IR_w) + (1/RfD_i \cdot K \cdot IR_a)]}{BW \cdot AT \cdot 365\ days/yr} \quad (30)$$

The definitions of variables in Equations 29 and 30, and the EPA recommended default values are provided in Table 5. Equations 29 and 30 present health effects as a function of concentration of chemical in groundwater. These equations can be inverted to solve for water concentrations or health-based criteria (C_{gwal}) for groundwater as follows:

$$C_{gwal} = \frac{TR \cdot BW \cdot AT \cdot 365\ days/yr}{EF \cdot ED \cdot [(SF_o \cdot IR_w) + (SF_i \cdot K \cdot IR_a)]} \quad (31)$$

and

$$C_{gwal} = \frac{THI \cdot BW \cdot AT \cdot 365\ days/yr}{EF \cdot ED \cdot [(1/RfD_o \cdot IR_w) + (1/RfD_i \cdot K \cdot IR_a)]} \quad (32)$$

If the default assumptions presented in Table 5 are used and a target cancer risk of 10^{-6} and target hazard index of 1 are assumed, the above equations reduce to, for carcinogens:

$$C_{gwal} = \frac{1.7 \cdot 10^{-4}}{(2 \cdot SF_o) + (7.5 \cdot SF_i)} \quad (33)$$

and, for noncarcinogens

$$C_{gwal} = \frac{60.8}{(2/RfD_o) + (7.5/RfD_i)} \quad (34)$$

TIER II CLEANUP GOALS

Cleanup goals were calculated for a representative set of chemicals for the Tier II Voluntary Remediation Program based on the procedures outlined above. Table 6 presents this list of chemicals along with analytical detection limits and a determination of whether or not the compound is considered bioaccumulative. Table 7 presents appropriate chemical properties and dose-response data used for calculation of health-based criteria. This representative list of chemicals includes semi-volatiles, volatiles, pesticides and PCBs and inorganics (i.e., metals and cyanide). Literature sources for chemical property data include the following:

- Howard, P.H. 1989. *Fate and Exposure Data for Organic Chemicals.* Lewis Publishers, Chelsia Michigan.

- EPA, 1989. *Hazardous Waste Treatment, Storage and Disposal Facilities (TSDF) - Air Emissions Models.* Appendix D: Properties for Chemicals of Interest. EPA-450/3-87-026. November. 1989.

- EPA. 1986. *Superfund Public Health Evaluation Manual.* Appendix A: Summary Tables for Chemical-Specific Data. EPA/540/1-86/060. October. 1986.

- PADER. 1990. *Risk Assessment/Fate and Transport Modeling System.* Appendix B: Selected Parameter Values for Common Contaminants. Bureau of Waste Management, Pennsylvania Dept. of Environmental Resources. July 13, 1990.

Dose-response data were obtained from the Integrated Risk Information System (IRIS, 1993), and if not available in IRIS, from the Health Effects Assessment Summary Tables (HEAST, 1992: with Supplemental Updates Nos. 1 and 2). Only dose-response data for chemicals with toxicity data from IRIS (1993) and HEAST (1992) were used with the exception of potentially carcinogenic PAHs. Seven of the priority pollutant PAHs are classified as B2 probable carcinogens (IRIS, 1992) as follows:

- benzo(a)pyrene;
- chrysene;
- benzo(a)anthracene;
- benzo(k)fluoranthene;
- benzo(b)fluoranthene;
- dibenzo(a,h)anthracene; and
- indeno(1,2,3-c,d)pyrene.

However, EPA-verified CSFs only exist for benzo(a)pyrene (IRIS. 1992). Therefore, cancer slope factors are needed to perform a carcinogenic assessment for the other 6 potentially carcinogenic PAHs. EPA is currently considering evaluating the carcinogenicity of the other potentially carcinogenic compounds based on a toxicity equivalency factor (TEF) approach relative to carcinogenicity of benzo(a)pyrene. An interim draft policy for evaluating the carcinogenicity of the other PAHs was released in 1990 (EPA. 1990. *Draft Interim Policy for*

Estimating Carcinogenic Risks Associated With Exposures to Polycyclic Aromatic Hydrocarbons (PAHs), OSWER Directive #9285-4-02). This draft interim policy first identified the TEF approach for assessing the carcinogenicity of PAHs other than benzo(a)pyrene. This was further supported by a recent EPA memo from Kenneth A. Poirer, Director of Superfund Health Risk Technical Support Center for Chemical Mixtures and Assessment Branch, concerning PAH toxicity (*Risk Assessment for Polyaromatic Hydrocarbons*, Memo to Sarah Levinson, EPA Region 1, January, 1992). Also, the Environmental Criteria and Assessment Office (ECAO) of EPA in Cincinnati was contacted concerning the appropriate methodology for the carcinogenic assessment of PAHs. Dr. Rita Schoeny, Associate Director of Science for ECAO, stated that a TEF approach is appropriate for evaluating the carcinogenicity for the other six potentially carcinogenic PAH compounds using the TEF factors relative to that of benzo(a)pyrene. These TEF factors are as follows:

PAH Compound		TEF	CSF
· benzo(a)pyrene	-	1	7.3
· benzo(a)anthracene	-	0.1	0.73
· benzo(b)fluoranthene	-	0.1	0.73
· benzo(k)fluoranthene	-	0.01	0.073
· chrysene	-	0.001	0.0073
· dibenzo(a,h)anthracene	-	1.0	7.3
· indeno(1,2,3-c,d)pyrene	-	0.1	0.73

Therefore, with the absence of verified EPA CSFs for PAHs other than benzo(a)pyrene, PAHs carcinogenicity were assessed based on the TEF approach, suggested by EPA and recommended by Dr. Schoeny of EPA's ECAO.

An overview of health-based cleanup goals by scenario (non-residential or residential) and by media are provided below.

Non-Residential Scenario

Groundwater: Cleanup goals for groundwater in the non-residential scenario were determined based on health-based criteria from direct contact using the default Equations 20 and 21. However, for implementation purposes for a site remediation program, health-based concentrations were compared to practical quantitation limits (PQLs) and drinking water criteria (i.e., non-zero maximum contaminant level goals [MCLGs] or maximum contaminant levels [MCLs] from the Safe Drinking Water Act) for determination of the cleanup goal. The practical quantitation limit is the lowest level that can be reliably achieved for a particular analyte within specified limits of precision and accuracy during routine laboratory operating conditions for a particular procedure. PQLs were determined based on *Test Methods for Evaluating Solid Waste* (EPA, 1986; SW-846). Representative test methods considered applicable for compounds in water include:

- Method 8270 for semi-volatiles;
- Method 8240 for volatiles;
- Method 8080 for pesticides and PCBs;

Method Series 200 for metals and inorganics.

However, final PQLs would vary according to the specific analytical method used. Health-based concentrations were first compared to PQLs. For those compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. Finally, health-based concentrations were compared to drinking water quality criteria (i.e., non-zero MCLGs and MCLs). For those compounds with criteria below MCLGs or MCLs, the cleanup goals were based on applicable drinking water criteria.

Table 8 presents applicable drinking water criteria, PQLs and health-based concentrations that were used to determine Tier II cleanup goals for groundwater in the non-residential scenario (i.e., on sites remediated for restricted future use). Health-based concentrations for carcinogens in the non-residential scenario were calculated assuming a 10^{-5} target risk level. Health-based concentrations for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative. Cleanup goals identified as NA for particular compounds indicate appropriate toxicity data is not available or not appropriate for that particular compound. For some compounds, cleanup goals were determined from both the carcinogenic and noncarcinogenic assessment. The appropriate cleanup goal would, therefore, be the lower of the two values. For other compounds, such as lead, no toxicity values were available and therefore, health-based cleanup goals could not be calculated based on this methodology. However, there are data available to assess cleanup goals for compounds such as lead, such as MCLs or other EPA documentation which should be consulted.

Surface Soils: Cleanup goals for surface soils in the non-residential scenario were determined based on health-based concentrations from direct contact using the default Equations 12 and 13. However, health-based concentrations were compared to practical quantitation limits (PQLs) for determination of the cleanup goal. The consideration of PQLs was considered necessary for application of cleanup goals to site remediation programs. For compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in surface soil according to the following criteria:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 9 presents PQLs and health-based concentrations that were used to determine Tier II cleanup goals for surface soils in the non-residential land use scenario (i.e., on sites remediated for restricted future use). Cleanup goals for carcinogens in the non-residential scenario were calculated assuming a 10^{-5} target risk level. Cleanup goals for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Subsurface Soils: Cleanup goals for subsurface soils in the non-residential scenario were determined based on two health-based criteria: direct contact using the default Equations 14 and 15; and based on leaching to groundwater and protection of a groundwater criteria or standard. The leaching pathway was not considered in the calculation of PRGs, however, the leaching of chemicals from soils to groundwater and the protection of groundwater was deemed an important consideration for establishing cleanup goals for subsurface soils. Subsurface soil concentrations that are considered protective of groundwater via leaching were calculated based on EPA's Organic Leaching Model (OLM) [*Final Organic Leaching Model (OLM)*; EPA 51 FR 41082, Nov. 13, 1986 - see Attachment II], which involves the equation:

$$C_l = 0.00211 * C_s^{0.678} * Sol^{0.373} \quad (35)$$

where: C_l = Concentration in the leachate (mg/L);
C_s = Concentration in the soil or solid media (mg/Kg); and
Sol = Aqueous solubility (mg/L).

By substituting a groundwater cleanup goal (C_{gw}) for C_l in Equation 35 and re-arranging term, an acceptable subsurface soil concentration (C_s) is calculated with the equation:

$$C_s = \left(\frac{C_{gw}}{0.00211 * Sol^{0.373}} \right)^{1/0.678} \quad (36)$$

The health-based criteria was the lower of the either the health-based concentration from the direct contact method or from the leaching method. However, as with surface soils, health-based criteria were compared to practical quantitation limits (PQLs) for determination of the final Tier II cleanup goal. This is necessary for implementation purposes in a remediation program on subsurface soils. For compounds having health-based criteria less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in subsurface soils, based on the discussion provided above for surface soils, including the following:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 10 presents PQLs and health-based concentrations from the direct contact and leaching methods for determination of Tier II cleanup goals for subsurface soils in the non-residential land use scenario (i.e., on sites remediated for restricted future use). Cleanup goals for carcinogens in subsurface soils from the non-residential scenario were calculated assuming a 10^{-5} target risk level. Cleanup goals for noncarcinogens were calculated based on a target

hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Residential Scenario

Groundwater: Cleanup goals for groundwater in the residential scenario were determined based on health-based criteria from direct contact using the default Equations 33 and 34. Health-based concentrations were compared to practical quantitation limits (PQLs) and non-zero maximum contaminant level goals (MCLGs) or maximum contaminant levels (MCLs) from the Safe Drinking Water Act, for determination of the cleanup goal. Health-based concentrations were first compared to PQLs. For those compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. Finally, health-based concentrations were compared to drinking water quality criteria (i.e., non-zero MCLGs and MCLs). For those compounds with criteria below MCLGs or MCLs, the cleanup goals were based on applicable drinking water criteria.

Table 11 presents applicable drinking water criteria. PQLs and health-based concentrations that were used to determine Tier II cleanup goals for groundwater in the residential scenario (i.e., on sites remediated for unrestricted future use). Health-based concentrations for carcinogens in the residential scenario were calculated assuming a 10^{-6} target risk level. Health-based concentrations for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Surface Soils: Cleanup goals for surface soils in the residential scenario were determined based on health-based concentrations from direct contact using the default Equations 27 and 28. Health-based concentrations were compared to practical quantitation limits (PQLs) for determination of the cleanup goal. For compounds having health-based concentrations less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in surface soils which include the following:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 12 presents PQLs and health-based concentrations that were used to determine Tier II cleanup goals for surface soils in the residential land use scenario (i.e., on sites remediated for unrestricted future use). Cleanup goals for carcinogens in the residential scenario were calculated assuming a 10^{-6} target risk level. Cleanup goals for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Subsurface Soils: Cleanup goals for subsurface soils in the residential scenario were determined based on the discussion provided above for the non-residential scenario. However, the applicable groundwater criteria for the leaching assessment were based on the groundwater criteria discussed above for the residential scenario. The health-based criteria was the lower of the either the health-based concentration from the direct contact method or from the leaching method. Health-based criteria were then compared to practical quantitation limits (PQLs) for determination of the final Tier II cleanup goal. For compounds having health-based criteria less than the PQL, the PQL was considered the cleanup goal. A maximum upper limit is proposed for each chemical class in subsurface soils which include the following:

- total semi-volatile compounds not to exceed 10,000 mg/Kg;
- total volatile compounds not to exceed 1,000 mg/Kg;
- total cyanide concentrations of 1,000 mg/Kg;
- total mercury concentrations of 1,000 mg/Kg; and
- total heavy metal concentrations not to exceed 10,000 mg/Kg.

These limits were established to be protective of other potential exposure pathways not evaluated in the calculation of health-based criteria.

Table 13 presents PQLs and health-based concentrations from the direct contact and leaching methods for determination of Tier II cleanup goals for subsurface soils in the residential land use scenario (i.e., on sites remediated for restricted future use). Cleanup goals for carcinogens in subsurface soils from the residential scenario were calculated assuming a 10^{-6} target risk level. Cleanup goals for noncarcinogens were calculated based on a target hazard index of 1, for non-bioaccumulative compounds, and 0.2 for compounds that are bioaccumulative.

Summary

This section discussed the calculation of cleanup goals for Tier II in the Voluntary Remediation Program. Cleanup goals were presented for surface soils, subsurface soils and groundwater separately for an non-residential and residential land use scenario. Tier II cleanup goals were presented for representative compounds. Tables 14 and 15 present cleanup goals for the non-residential and residential scenarios, respectively. Cleanup goals were determined based on health-based concentrations from a human health risk assessment. However, the determination of cleanup goals also considered practical quantitation limits (PQLs) based on available analytical methods for soils and groundwater. PQLs must be considered when establishing definable cleanup goals to be met in a site remediation program.

TABLE 1
INTAKE ASSUMPTIONS FOR EXPOSURE TO SURFACE SOILS IN THE INDUSTRIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Surface Soil		
C_t	chemical concentration in soil (mg/Kg)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-5} (industrial)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
SF_i	inhalation cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
RfD_i	inhalation reference dose (mg/Kg/day)	chemical–specific
AT	averaging time (yr)	70 yr – carcinogenic 25 yr – noncarcinogenic
EF	exposure frequency (days/yr)	250 days/yr
ED	exposure duration (yr)	25 yr
IR_{soil}	soil ingestion rate (mg/day)	50 mg/day
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
VF	volatilization factor (m^3/Kg)	(see Equation 7 and factors below)
PEF	particulate emissions factor (m^3/Kg)	(see Equation 9 and factors below)
Assumptions for Estimation of Volatilization Factor (VF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (cm^2)	20.250.000 cm^2
D_d	effective diffusivity (cm^2)	$D_i \times E^{0.33}$
E	true soil porosity (unitless)	0.35
K_{sa}	soil/air partition coefficient (g soil/cm^3 air)	$(H/K_d) \times 41$, where 41 is a units conversion factor
ρ_s	true soil density or particulate density (g/cm^3)	2.65 g/cm^3
T	exposure interval (s)	7.90E+08 s
D_i	molecular diffusivity (cm^2/s)	chemical–specific
H	Henry's law constant (atm–m^3/mol)	chemical–specific
K_d	soil–water partition coefficient (cm^3/g)	chemical–specific, or $K_{oc} \times OC$
K_{oc}	organic carbon partition coefficient (cm^3/g)	chemical–specific
OC	organic carbon content of soil (fraction)	site–specific, or 0.02
Assumptions for Estimation of Particulate Emission Factor (PEF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (m^2)	2.025 m^2
0.036	respirable fraction (g/m^2–hr)	0.036 g/m^2–hr
G	fraction of vegetative cover (unitless)	0
U_m	mean annual wind speed (m/s)	4.5 m/s
U_t	equivalent threshold value of windspeed at 10 m (m/s)	12.8 m/s
F(x)	function dependent on U_m/U_t	0.0497

TABLE 2
INTAKE ASSUMPTIONS FOR EXPOSURE TO SUBSURFACE SOILS IN THE INDUSTRIAL AND RESIDENTIAL SCENARIOS

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Subsurface Soil		
C_t	chemical concentration in soil (mg/Kg)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-5} (industrial)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
SF_i	inhalation cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
RfD_i	inhalation reference dose (mg/Kg/day)	chemical–specific
AT	averaging time (yr)	70 yr – carcinogenic 2 yr – noncarcinogenic
EF	exposure frequency (days/yr)	175 5 days/wk. 35 weeks/yr
ED	exposure duration (yr)	2 yr
IR_{soil}	soil ingestion rate (mg/day)	100 mg/day
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
VF	volatilization factor (m^3/Kg)	(see Equation 7 and factors below)
PEF	particulate emissions factor (m^3/Kg)	(see Equation 9 and factors below)
Assumptions for Estimation of Volatilization Factor (VF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (cm^2)	20.250.000 cm^2
D_{ei}	effective diffusivity (cm^2)	$D_i \times E^{0.33}$
E	true soil porosity (unitless)	0.35
K_{sa}	soil/air partition coefficient (g soil/cm^3 air)	(H/K_s) x 41. where 41 is a units conversion factor
ρ_s	true soil density or particulate density (g/cm^3)	2.65 g/cm^3
T	exposure interval (s)	7.90E+08 s
D_i	molecular diffusivity (cm^2/s)	chemical–specific
H	Henry's law constant (atm–m^3/mol)	chemical–specific
K_d	soil–water partition coefficient (cm^3/g)	chemical–specific, or K_{oc} x OC
K_{oc}	organic carbon partition coefficient (cm^3/g)	chemical–specific
OC	organic carbon content of soil (fraction)	site–specific, or 0.02
Assumptions for Estimation of Particulate Emission Factor (PEF)		
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (m^2)	2.025 m^2
0.036	respirable fraction (g/m^2–hr)	0.036 g/m^2–hr
G	fraction of vegetative cover (unitless)	0
U_m	mean annual wind speed (m/s)	4.5 m/s
U_t	equivalent threshold value of windspeed at 10 m (m/s)	12.8 m/s
F(x)	function dependent on U_m/U_t	0.0497

TABLE 3
INTAKE ASSUMPTIONS FOR EXPOSURE TO GROUNDWATER IN THE INDUSTRIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Groundwater		
Cw	chemical concentration in water (mg/L)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-5} (industrial)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor ((mg/Kg–day)$^{-1}$)	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
BW	adult body weight (Kg)	70 Kg
AT	averaging time (yr)	70 yr – carcinogenic 25 yr – noncarcinogenic
EF	exposure frequency (days/yr)	250 days/yr
ED	exposure duration (yr)	25 yr
IR_w	daily water ingestion rate (L/day)	1 L/day

TABLE 4
INTAKE ASSUMPTIONS FOR EXPOSURE TO SURFACE SOILS IN THE RESIDENTIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Surface Soil		
C_t	chemical concentration in soil (mg/Kg)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-6} (residenual)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $(mg/Kg-day)^{-1}$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
AT	averaging time (yr)	70 yr – carcinogenic
		30 yr – noncarcinogenic
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yr)	30 yr
$IF_{soil/adj}$	age–adjusted ingestion factor(mg–yr/Kg–day)	114 mg–yr/Kg–day
Assumptions for Calculation of $IF_{soil/adj}$		
$BW_{age\ 1-6}$	average body weight from ages 1–6 (Kg)	15 Kg
$BW_{age\ 7-31}$	average body weight from ages 7–31 (Kg)	70 Kg
$ED_{age\ 1-6}$	exposure duration during ages 1–6 (yr)	6 yr
$ED_{age\ 7-31}$	exposure duration during ages 7–31 (yr)	24 yr
$IR_{soil/age\ 1-6}$	ingestion rate of soil age 1 to 6 (mg/day)	200 mg/day
$IR_{soil/age\ 7-31}$	ingestion rate of soil all other ages (mg/day)	100 mg/day

TABLE 5
INTAKE ASSUMPTIONS FOR EXPOSURE TO GROUNDWATER IN THE RESIDENTIAL SCENARIO

Parameters	Definition (units)	Default Value
Assumptions For Calculation of Cleanup Goals for Groundwater		
Cw	chemical concentration in water (mg/L)	–
TR	target excess individual lifetime cancer risk (unitless)	10^{-6} (residential)
THI	target acceptable hazard index (unitless)	1
SF_o	oral cancer slope factor $((mg/Kg-day)^{-1})$	chemical–specific
RfD_o	oral reference dose (mg/Kg/day)	chemical–specific
SF_i	inhalation cancer slope factor $((mg/Kg-day)^{-1})$	chemical–specific
RfD_i	inhalation reference dose (mg/Kg/day)	chemical–specific
BW	adult body weight (Kg)	70 Kg
AT	averaging time (yr)	70 yr – carcinogenic
		25 yr – noncarcinogenic
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yr)	30 yr
IR_a	daily indoor inhalation rate (m^3/day)	15 m^3/day
IR_w	daily water ingestion rate (L/day)	2 L/day
K	volatilization factor (unitless)	0.0005*1000 L/m^3 (Andelman 1990)

TABLE 6
REPRESENTATIVE COMPOUNDS AND CHARACTERISTICS

Chemical Name	Compound Type[a]	Compound is Considered Bioaccumulatable[b] (yes/no)	Maximum Contaminant Level (MCL) (mg/L)	Maximum Contaminant Level Goal (MCLG) (mg/L)	Practical or Estimated Quantitation Limits[c]			
					Low Contaminated Soil		Groundwater	
					Value (mg/Kg)	Method	Value (mg/L)	Method
naphthalene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
acenaphthylene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
acenaphthene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
fluorene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
phenanthrene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
anthracene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
fluoranthene	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
pyrene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(a)anthracene	semivolatile	yes	0.0001	0	0.66	SW846 – 8270	0.01	SW846 – 8270
chrysene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(b)fluoranthene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(k)fluoranthene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(a)pyrene	semivolatile	yes	0.0002	0	0.66	SW846 – 8270	0.01	SW846 – 8270
indeno(1,2,3-cd)pyrene	semivolatile	yes	0.0004	0	0.66	SW846 – 8270	0.01	SW846 – 8270
dibenzo(a,h)anthracene	semivolatile	yes	0.0003	0	0.66	SW846 – 8270	0.01	SW846 – 8270
benzo(g,h,i)perylene	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
3,3'-dichlorobenzidine	semivolatile	no			1.3	SW846 – 8270	0.02	SW846 – 8270
n-nitroso-di-n-propylamine	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
bis(2-chloroisopropyl)ether	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
4-chloroaniline	semivolatile	no			1.3	SW846 – 8270	0.02	SW846 – 8270
2-chloronaphthalene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4-dinitrotoluene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
hexachlorobutadiene	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
hexachloroethane	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
isophorone	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
benzyl alcohol	semivolatile	no			1.3	SW846 – 8270	0.02	SW846 – 8270
bis(2-chloroethyl)ether	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
nitrobenzene	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
1,2-dichlorobenzene	semivolatile	no	0.6	0.6	0.66	SW846 – 8270	0.01	SW846 – 8270
1,3-dichlorobenzene	semivolatile	no	0.6	0.6	0.66	SW846 – 8270	0.01	SW846 – 8270
1,4-dichlorobenzene	semivolatile	no	0.075	0.075	0.66	SW846 – 8270	0.01	SW846 – 8270
1,2,4-trichlorobenzene	semivolatile	no	0.07	0.07	0.66	SW846 – 8270	0.01	SW846 – 8270
hexachlorobenzene	semivolatile	no	0.001	0	0.66	SW846 – 8270	0.01	SW846 – 8270
hexachlorocyclopentadiene	semivolatile	no	0.05	0.05	0.66	SW846 – 8270	0.01	SW846 – 8270
n-nitrosodiphenylamine	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
benzoic acid	semivolatile	no			3.3	SW846 – 8270	0.05	SW846 – 8270
2-nitroaniline	semivolatile	no			3.3	SW846 – 8270	0.05	SW846 – 8270
phenol	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
2-methylphenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
3-methylphenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
4-methylphenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2-chlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4-dichlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4,5-trichlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
2,4,6-trichlorophenol	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
pentachlorophenol	semivolatile	no	0.001	0	3.3	SW846 – 8270	0.05	SW846 – 8270
2,4-dinitrophenol	semivolatile	no			3.3	SW846 – 8270	0.05	SW846 – 8270
bis(2-ethylhexyl)phthalate	semivolatile	yes	0.006	0	0.66	SW846 – 8270	0.01	SW846 – 8270
butylbenzylphthalate	semivolatile	no	0.1	0	0.66	SW846 – 8270	0.01	SW846 – 8270
di-n-butylphthalate	semivolatile	yes			0.66	SW846 – 8270	0.01	SW846 – 8270
diethylphthalate	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
di methyl phthalate	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270
di-n-octyl phthalate	semivolatile	no			0.66	SW846 – 8270	0.01	SW846 – 8270

TABLE 6 (con't)
REPRESENTATIVE COMPOUNDS AND CHARACTERISTICS

Chemical Name	Compound Type[a]	Compound is Considered Bioaccumulatable[b] (yes/no)	Maximum Contaminant Level (MCL) (mg/L)	Maximum Contaminant Level Goal (MCLG) (mg/L)	Practical or Estimated Quantitation Limits[c] Low Contammated Soil Value (mg/Kg)	Method	Groundwater Value (mg/L)	Method
benzene	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
toluene	volatile	no	1	1	0.005	SW846 – 8240	0.005	SW846 – 8240
ethylbenzene	volatile	no	0.7	0.7	0.005	SW846 – 8240	0.005	SW846 – 8240
xylenes	volatile	no	10	10	0.005	SW846 – 8240	0.005	SW846 – 8240
vinyl chloride	volatile	no	0.002	0	0.01	SW846 – 8240	0.01	SW846 – 8240
chloroethane	volatile	no			0.01	SW846 – 8240	0.01	SW846 – 8240
1,1-dichloroethylene	volatile	no	0.007	0.007	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1-dichloroethane	volatile	no			0.005	SW846 – 8240	0.005	SW846 – 8240
1,2-dichloroethylene (cis)	volatile	no	0.07	0.07	0.005	SW846 – 8240	0.005	SW846 – 8240
1,2-dichloroethane	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
trichloroethylene	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,1-trichloroethane	volatile	no	0.2	0.2	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,2-trichloroethane	volatile	no	0.005	0.003	0.005	SW846 – 8240	0.005	SW846 – 8240
tetrachloroethylene	volatile	no	0.005	0	0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,1,2-tetrachloroethane	volatile	no			0.005	SW846 – 8240	0.005	SW846 – 8240
1,1,2,2-tetrachloroethane	volatile	no			0.005	SW846 – 8240	0.005	SW846 – 8240
chloroform	volatile	no	0.1		0.005	SW846 – 8240	0.005	SW846 – 8240
acetone	volatile	no			0.1	SW846 – 8240	0.1	SW846 – 8240
4-methyl-2-pentanone	volatile	no			0.05	SW846 – 8240	0.05	SW846 – 8240
methyl ethyl ketone	volatile	no			0.1	SW846 – 8240	0.1	SW846 – 8240
Aldrin	pest/herb/PCB	yes			0.00268	SW846 – 8080	0.0000	SW846 – 8080
gamma-BHC (Lindane)	pest/herb/PCB	yes	0.0002	0.0002	0.00603	SW846 – 8080	0.0000	SW846 – 8080
chlordane	pest/herb/PCB	yes	0.002	0	0.00938	SW846 – 8080	0.0001	SW846 – 8080
DDD	pest/herb/PCB	yes			0.00737	SW846 – 8080	0.0001	SW846 – 8080
DDE	pest/herb/PCB	yes			0.00268	SW846 – 8080	0.0000	SW846 – 8080
DDT	pest/herb/PCB	yes			0.00804	SW846 – 8080	0.0001	SW846 – 8080
dieldrin	pest/herb/PCB	yes			0.00134	SW846 – 8080	0.0000	SW846 – 8080
endosulfan sulfate	pest/herb/PCB	no			0.04422	SW846 – 8080	0.0006	SW846 – 8080
endrin	pest/herb/PCB	yes	0.002	0.002	0.00402	SW846 – 8080	0.0000	SW846 – 8080
heptachlor	pest/herb/PCB	yes	0.0004	0	0.00201	SW846 – 8080	0.0000	SW846 – 8080
heptachlor epoxide	pest/herb/PCB	no	0.0002	0	0.05561	SW846 – 8080	0.0008	SW846 – 8080
PCBs	pest/herb/PCB	yes	0.0005	0	0.04355	SW846 – 8080	0.0006	SW846 – 8080
lead	inorganic	no	0.015	0	0.5	SW846 – 7421	0.003	SW846-200.7
cadmium	inorganic	no	0.005	0.005	0.5	SW846 – 6010	0.005	SW846-200.7
silver	inorganic	no			1	SW846 – 6010	0.01	SW846-200.7
mercury	inorganic	yes	0.002	0.002	0.1	SW846 – 7471	0.0002	SW846-245.1
chromium vi	inorganic	no	0.1	0.1	1	SW846 – 7196	0.01	SW846-7196
chromium iii	inorganic	no	0.1	0.1	1	SW846 – 6010	0.01	SW846-200.7
barium	inorganic	no	2	2	20	SW846 – 6010	0.2	SW846-200.7
arsenic	inorganic	no	0.05		1	SW846 – 7060	0.01	SW846-206.2
antimony	inorganic	no	0.006	0.006	6	SW846 – 7041	0.06	SW846-204.2
beryllium	inorganic	no	0.004	0.004	0.5	SW846 – 6010	0.005	SW846-200.7
cyanide	inorganic	no	0.2	0.2	0.125	SW846 – 9012	0.01	SW846-335.3
nickel	inorganic	no	0.1	0.1	4	SW846 – 6010	0.04	SW846-200.7
selenium	inorganic	no	0.05	0.05	0.5	SW846 – 7740	0.005	SW846-270.2
vanadium	inorganic	no			5	SW846 – 6010	0.05	SW846-200.7
zinc	inorganic	no			2	SW846 – 6010	0.02	SW846-200.7

NOTES: a – Determined according to analytical methods summarized in *Test Methods for Evaluating Solid Waste*, EPA SW-846.

b – Determined according to *Water Quality Criteria for Specific Substances*, Ind. Reg. Vol 17, No. 7, April 1, 1993.

c – Practical quantitation limits based on *Test Methods for Evaluating Solid Waste*, EPA SW-846, 1986 for GC/MS methods. However, PQLs will change according to the specific analytical method used.

TABLE 7
SUMMARY OF CHEMICAL PROPERTIES AND DOSE-RESPONSE

Chemical Name	CHEMICAL PROPERTIES: Molecular Weight [MW] (g/g-mol)	Org Car Part-Koc [KOC] (L/Kg)	Aqueous Solubil [SOL] (mg/L)	Henry Law [H] (atm/mol)	Vapor Phase Diffus Coeff. [D_i] (cm2/s)	DOSE-RESPONSE DATA: Reference Doses Oral mg/kg/day	Reference Doses Inhalation mg/kg/day	Cancer Slope Factors Oral (mg/kg/day)$^{-1}$	Cancer Slope Factors Inhalation (mg/kg/day)$^{-1}$
naphthalene	128.2	1.28E+03	31.7	1.18E-03	5.90E-02	0.04			
acenaphthylene	152.21	4.79E+03	3.93	1.14E-04	6.60E-02				
acenaphthene	154.21	1.78E+01	3.42	7.71E-03	6.50E-02	0.06			
fluorene	166	5.01E+03	1.69	1.17E-04	6.20E-02	0.04			
phenanthrene	178.22	1.67E+04	1	6.05E-03	5.90E-02				
anthracene	178.23	2.17E+04	0.045	8.60E-05	5.90E-02	0.3			
fluoranthene	202	4.17E+04	0.26	6.73E-02	5.60E-02	0.04			
pyrene	202.3	6.90E+04	0.132	7.00E-09	5.50E-02	0.03			
benzo(a)anthracene	228.3	1.38E+06	0.014	1.38E-09	4.30E-02			0.73	
chrysene	228.2	2.45E+05	0.002	1.18E-09	5.10E-02			0.0073	
benzo(b)fluoranthene	252.32	5.50E+05	0.0015	1.19E-05	5.00E-02			0.73	
benzo(k)fluoranthene	252.32	4.37E+06	0.0008	3.94E-05	4.70E-02			0.073	
benzo(a)pyrene	252.3	8.81E+05	0.0038	1.38E-09	4.30E-02			7.3	6.1
indeno(1,2,3-cd)pyrene	276.34	3.09E+07	0.00053	6.86E-08	4.60E-02			0.73	
dibenzo(a,h)anthracene	278.35	1.84E+06	0.0005	7.33E-08	4.50E-02			7.3	
benzo(g,h,i)perylene	276.34	7.76E+06	0.00026	5.34E-08	4.80E-02				
3,3'-dichlorobenzidine	253.13	2.00E+03	4	8.33E-07	NA			0.45	
n-nitroso-di-n-propylamine	130.19	1.02E+01	9900	NA	NA			7	
bis(2-chloroisopropyl)ether	171.1	6.17E+01	1700	1.13E-04	6.02E-02	0.04		0.07	0.035
4-chloroaniline	127.47	3.23E+02	3.9	1.07E-05	7.50E-02	0.004			
2-chloronaphthalene	162.62	8.51E+03	6.74	1.82E-02	6.60E-02	0.08			
2,4-dinitrotoluene	182.1	6.17E+01	270	4.07E-06	2.03E-01	0.002			
hexachlorobutadiene	260.8	4.68E+03	2	4.57E+00	5.61E-02	0.002		0.078	0.078
hexachloroethane	237	2.19E+03	50	2.49E-06	6.50E-02	0.001		0.0142	0.0142
isophorone	138.21	3.09E+01	12000	5.76E-06	6.23E-02	0.2		0.00095	
benzyl alcohol	108.15	9.55E+01	35000	6.10E-07	7.90E-02	0.3			
bis(2-chloroethyl)ether	143	1.41E+01	10200	1.30E-05	6.92E-02			1.1	1.1
nitrobenzene	123.1	9.72E+01	1900	1.31E-05	7.60E-02	0.0005			
1,2-dichlorobenzene	147	3.66E+02	145	1.94E-03	6.90E-02	0.09			
1,3-dichlorobenzene	147.01	4.40E+02	123	3.61E-03	6.98E-02				
1,4-dichlorobenzene	147	2.09E+02	79	1.60E-03	6.90E-02		0.19999	0.024	
1,2,4-trichlorobenzene	181.5	9.39E+02	30	1.42E-03	6.80E-02	0.01			
hexachlorobenzene	284.8	4.55E+03	0.006	6.80E-04	5.42E-02	0.0008		1.6	1.6
hexachlorocyclopentadiene	272.77	4.27E+03	1.8	1.37E-02	5.61E-02	0.007	0.00001		
n-nitrosodiphenylamine	198.23	5.75E+02	34.7	NA	9.70E-02			0.0049	
benzoic acid	122.13	1.40E+02	2700	1.82E-08	7.40E-02	4			
2-nitroaniline	138.14	2.66E+01	1280	5.00E-07	7.30E-02	0.00006	0.00005		
phenol	94.1	2.19E+01	93000	4.54E-07	8.20E-02	0.6			
2-methylphenol	108.1	2.19E+01	24660	2.60E-06	7.40E-02	0.05			
3-methylphenol	108.1	3.50E+01	21928	4.43E-07	7.40E-02				
4-methylphenol	108.1	1.57E+02	19543	4.43E-07	7.90E-02	0.05			
2-chlorophenol	128.6	3.63E+02	28500	1.78E-05	7.90E-02	0.005			
2,4-dichlorophenol	163.01	7.00E+02	4500	4.80E-06	7.10E-02	0.003			
2,4,5-trichlorophenol	197.45	1.74E+03	1202	2.18E-04	6.50E-02	0.1			
2,4,6-trichlorophenol	197.46	7.19E+02	800	1.77E-05	6.60E-02			0.011	0.01
pentachlorophenol	266.4	2.63E+03	14	2.80E-06	5.60E-02	0.03		0.12	
2,4-dinitrophenol	184	1.78E+01	5600	1.53E-07	2.73E-02	0.002			
bis(2-ethylhexyl)phthalate	391.07	1.00E+05	0.4	3.00E-07	3.51E-02	0.02		0.014	
butylbenzylphthalate	312.39	1.53E+02	2.9	1.08E-02	4.30E-02	0.2			
di-n-butylphthalate	278.3	1.38E+03	13	2.80E-07	4.38E-02	0.1			
diethylphthalate	222	6.92E+01	896	1.11E-02	5.30E-02	0.8			
di methyl phthalate	194.2	1.91E+02	4320	2.15E-06	5.68E-02	10			
di-n-octyl phthalate	390.58	9.77E+08	3	1.37E-01	3.60E-02	0.02			

TABLE 7 (con't)
SUMMARY OF CHEMICAL PROPERTIES AND DOSE-RESPONSE

Chemical Name	CHEMICAL PROPERTIES: Molecular Weight [MW] (g/g-mol)	Org Car Part-Koc [KOC] (L/Kg)	Aqueous Solubil [SOL] (mg/L)	Henry Law [H] (atm/mol)	Vapor Phase Diffus Coeff. [D_i] (cm2/s)	DOSE-RESPONSE DATA: Reference Doses Oral mg/kg/day	Reference Doses Inhalation mg/kg/day	Cancer Slope Factors Oral $(mg/kg/day)^{-1}$	Cancer Slope Factors Inhalation $(mg/kg/day)^{-1}$
benzene	78.1	7.91E+01	1750	5.50E-03	8.80E-02			0.029	0.029
toluene	92.4	1.62E+02	535	6.68E-03	8.70E-02	0.2	0.11428		
ethylbenzene	106.2	1.81E+02	152	6.44E-03	7.50E-02	0.1	0.28571		
xylenes	106.2	3.32E+02	198	7.04E-03	7.47E-02	2			
vinyl chloride	62.5	2.45E+00	2670	8.60E-02	1.06E-01			1.9	0.3
chloroethane	64.52	3.24E+00	5740	1.11E-02	2.71E-01		2.857		
1,1-dichloroethylene	97	6.46E+01	2250	2.61E-02	1.00E-01	0.009		0.6	1.2
1,1-dichloroethane	98.96	3.02E+01	5500	5.62E-03	9.60E-02	0.1	0.1		
1,2-dichloroethylene (cis)	96.95	4.90E+01	3500	4.08E-03	7.36E-02	0.01			
1,2-dichloroethane	99	1.64E+01	8520	9.78E-04	1.04E-01	0.3		0.091	0.091
trichloroethylene	131.4	9.63E+01	1100	9.58E-03	7.90E-02	0.006		0.011	0.017
1,1,1-trichloroethane	133.4	1.42E+02	1500	1.72E-02	7.80E-02	0.09	0.3		
1,1,2-trichloroethane	133.4	6.87E+01	4500	7.42E-04	7.80E-02	0.004		0.057	0.057
tetrachloroethylene	165.83	6.69E+01	150	2.87E-02	7.20E-02	0.01		0.051	0.00182
1,1,1,2-tetrachloroethane	168	3.99E+02	1099	2.00E-03	7.10E-02	0.03		0.026	0.026
1,1,2,2-tetrachloroethane	168	7.55E+01	2900	3.80E-04	7.10E-02			0.2	0.02
chloroform	119.4	4.42E+01	8200	3.39E-03	1.04E-01	0.01		0.0061	0.0805
acetone	58	3.72E-01	1000000	2.50E-05	1.24E-01	0.1			
4-methyl-2-pentanone	100.16	6.17E+00	21300	4.95E-05	7.50E-02	0.05			
methyl ethyl ketone	72.1	1.23E+00	137190	4.35E-05	8.08E-02	0.05	0.2857		
Aldrin	364.93	4.07E+02	0.18	4.96E-04	5.00E-02	0.00003		17	17.1
gamma-BHC (Lindane)	290.83	1.32E+03	7.8	4.93E-07	5.30E-02	0.0003		1.3	
chlordane	410	2.29E+05	0.056	3.67E-05	4.80E-02	0.00006		1.3	1.29
DDD	320.05	4.37E+04	0.09	3.89E-05	5.00E-02			0.24	
DDE	318.03	4.93E+05	0.014	3.89E-05	4.90E-02			0.34	
DDT	354.49	3.13E+05	0.005	3.89E-05	4.70E-02	0.0005		0.34	0.34
dieldrin	380.93	2.07E+04	0.195	5.84E-05	NA	0.00005		16	16.1
endosulfan sulfate	422.9	2.34E+03	0.117	NA	NA	0.00005			
endrin	380.93	8.32E+03	0.26	NA	4.70E-02	0.0003			
heptachlor	373.35	2.19E+04	0.18	8.19E-04	5.10E-02	0.0005		4.5	4.55
heptachlor epoxide	389.2	2.09E+04	0.35	3.50E-01	NA	0.00001		9.1	9.1
PCBs	328	5.30E+05	0.0031	1.07E-03	4.80E-02			7.7	
lead	207.19	NA	NA	NA	5.50E-02				
cadmium	112	NA	NA	NA	5.50E-02	0.0005			6.1
silver	107.9	NA	NA	NA	NA	0.005			
mercury	200.59	NA	NA	1.14E-02	2.76E-02	0.0003	0.00008		
chromium vi	52	NA	NA	NA	NA	0.005			41
chromium iii	52	NA	NA	NA	NA	1			
barium	137	NA	NA	NA	NA	0.07			
arsenic	74.92	NA	NA	NA	5.50E-02	0.0003			50
antimony	121.8	NA	NA	NA	NA	0.0004			
beryllium	9.012	NA	0.2	NA	NA	0.005		4.3	8.4
cyanide	27	1.00E+00	1000000	2.70E-06	NA	0.02			
nickel	58.7	NA	NA	NA	NA	0.02			0.84
selenium	78.96	NA	NA	NA	NA	0.005			
vanadium	51	NA	NA	NA	NA	0.007			
zinc	65	NA	NA	NA	5.50E-02	0.3			

NOTES: * - Assumes TEF approach.
NA - Data not available or not applicable.

TABLE 8 REV: 11/01/93
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater		Groundwater Criteria (mg/L)
				Carcinogenic Effects @10^{-5} (mg/L)	Noncarcinogenic Effects (mg/L)	
naphthalene	no		0.01	NA	4.09E+00	4.09E+00
acenaphthylene	no		0.01	NA	NA	NA
acenaphthene	no		0.01	NA	6.13E+00	6.13E+00
fluorene	no		0.01	NA	4.09E+00	4.09E+00
phenanthrene	no		0.01	NA	NA	NA
anthracene	no		0.01	NA	3.07E+01	3.07E+01
fluoranthene	yes		0.01	NA	8.18E-01	8.18E-01
pyrene	no		0.01	NA	3.07E+00	3.07E+00
benzo(a)anthracene	yes	0.0001	0.01	3.92E-03	NA	1.00E-02
chrysene	yes	0.0002	0.01	3.92E-01	NA	3.92E-01
benzo(b)fluoranthene	yes	0.0002	0.01	3.92E-03	NA	1.00E-02
benzo(k)fluoranthene	yes	0.0002	0.01	3.92E-02	NA	3.92E-02
benzo(a)pyrene	yes	0.0002	0.01	3.92E-04	NA	1.00E-02
indeno(1,2,3-cd)pyrene	yes	0.0004	0.01	3.92E-03	NA	1.00E-02
dibenzo(a,h)anthracene	yes	0.0003	0.01	3.92E-04	NA	1.00E-02
benzo(g,h,i)perylene	yes		0.01	NA	NA	NA
3,3'-dichlorobenzidine	no		0.02	6.36E-03	NA	2.00E-02
n-nitroso-di-n-propylamine	no		0.01	4.09E-04	NA	1.00E-02
bis(2-chloroisopropyl)ether	no		0.01	4.09E-02	4.09E+00	4.09E-02
4-chloroaniline	no		0.02	NA	4.09E-01	4.09E-01
2-chloronaphthalene	no		0.01	NA	8.18E+00	8.18E+00
2,4-dinitrotoluene	no		0.01	NA	2.04E-01	2.04E-01
hexachlorobutadiene	yes		0.01	3.67E-02	4.09E-02	3.67E-02
hexachloroethane	yes		0.01	2.01E-01	2.04E-02	2.04E-02
isophorone	no		0.01	3.01E+00	2.04E+01	3.01E+00
benzyl alcohol	no		0.02	NA	3.07E+01	3.07E+01
bis(2-chloroethyl)ether	no		0.01	2.60E-03	NA	1.00E-02
nitrobenzene	no		0.01	NA	5.11E-02	5.11E-02
1,2-dichlorobenzene	no	0.6	0.01	NA	9.20E+00	9.20E+00
1,3-dichlorobenzene	no	0.6	0.01	NA	NA	NA
1,4-dichlorobenzene	no	0.075	0.01	1.19E-01	NA	1.19E-01
1,2,4-trichlorobenzene	no	0.07	0.01	NA	1.02E+00	1.02E+00
hexachlorobenzene	no	0.001	0.01	1.79E-03	8.18E-02	1.00E-02
hexachlorocyclopentadiene	no	0.05	0.01	NA	7.15E-01	7.15E-01
n-nitrosodiphenylamine	no		0.01	5.84E-01	NA	5.84E-01
benzoic acid	no		0.05	NA	4.09E+02	4.09E+02
2-nitroaniline	no		0.05	NA	6.13E-03	5.00E-02
phenol	yes		0.01	NA	1.23E+01	1.23E+01
2-methylphenol	no		0.01	NA	5.11E+00	5.11E+00
3-methylphenol	no		0.01	NA	NA	NA
4-methylphenol	no		0.01	NA	5.11E+00	5.11E+00
2-chlorophenol	no		0.01	NA	5.11E-01	5.11E-01
2,4-dichlorophenol	no		0.01	NA	3.07E-01	3.07E-01
2,4,5-trichlorophenol	no		0.01	NA	1.02E+01	1.02E+01
2,4,6-trichlorophenol	no		0.01	2.60E-01	NA	2.60E-01
pentachlorophenol	no	0.001	0.05	2.38E-02	3.07E+00	5.00E-02
2,4-dinitrophenol	no		0.05	NA	2.04E-01	2.04E-01
bis(2-ethylhexyl)phthalate	yes	0.006	0.01	2.04E-01	4.09E-01	2.04E-01
butylbenzylphthalate	no	0.1	0.01	NA	2.04E+01	2.04E+01
di-n-butylphthalate	yes		0.01	NA	2.04E+00	2.04E+00
diethylphthalate	no		0.01	NA	8.18E+01	8.18E+01
dimethyl phthalate	no		0.01	NA	1.02E+03	1.02E+03
di-n-octyl phthalate	no		0.01	NA	2.04E+00	2.04E+00

TABLE 8 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

REV 11/01/93

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater: Carcinogenic Effects @10^{-5} (mg/L)	Groundwater: Noncarcinogenic Effects (mg/L)	Groundwater Criteria (mg/L)
benzene	no	0.005	0.005	9.86E-02	NA	9.86E-02
toluene	no	1	0.005	NA	2.04E+01	2.04E+01
ethylbenzene	no	0.7	0.005	NA	1.02E+01	1.02E+01
xylenes	no	10	0.005	NA	2.04E+02	2.04E+02
vinyl chloride	no	0.002	0.01	1.51E-03	NA	1.00E-02
chloroethane	no		0.01	NA	NA	NA
1,1-dichloroethylene	no	0.007	0.005	4.77E-03	9.20E-01	7.00E-03
1,1-dichloroethane	no		0.005	NA	1.02E+01	1.02E+01
1,2-dichloroethylene (cis)	no	0.07	0.005	NA	1.02E+00	1.02E+00
1,2-dichloroethane	no	0.005	0.005	3.14E-02	3.07E+01	3.14E-02
trichloroethylene	no	0.005	0.005	2.60E-01	6.13E-01	2.60E-01
1,1,1-trichloroethane	no	0.2	0.005	NA	9.20E+00	9.20E+00
1,1,2-trichloroethane	no	0.003	0.005	5.02E-02	4.09E-01	5.02E-02
tetrachloroethylene	no	0.005	0.005	5.61E-02	1.02E+00	5.61E-02
1,1,1,2-tetrachloroethane	no		0.005	1.10E-01	3.07E+00	1.10E-01
1,1,2,2-tetrachloroethane	no		0.005	1.43E-02	NA	1.43E-02
chloroform	no	0.1	0.005	4.69E-01	1.02E+00	4.69E-01
acetone	no		0.1	NA	1.02E+01	1.02E+01
4-methyl-2-pentanone	no		0.05	NA	5.11E+00	5.11E+00
methyl ethyl ketone	no		0.1	NA	5.11E+00	5.11E+00
Aldrin	yes		0.00004	1.68E-04	6.13E-04	1.68E-04
gamma-BHC (Lindane)	yes	0.0002	0.00009	2.20E-03	6.13E-03	2.20E-03
chlordane	yes	0.002	0.00014	2.20E-03	1.23E-03	2.00E-03
DDD	yes		0.00011	1.19E-02	NA	1.19E-02
DDE	yes		0.00004	8.41E-03	NA	8.41E-03
DDT	yes		0.00012	8.41E-03	1.02E-02	8.41E-03
dieldrin	yes		0.00002	1.79E-04	1.02E-03	1.79E-04
endosulfan sulfate	no		0.00066	NA	5.11E-03	5.11E-03
endrin	yes	0.002	0.00006	NA	6.13E-03	6.13E-03
heptachlor	yes	0.0004	0.00003	6.36E-04	1.02E-02	6.36E-04
heptachlor epoxide	no	0.0002	0.00083	3.14E-04	1.33E-03	8.30E-04
PCBs	yes	0.0005	0.00065	3.71E-04	NA	6.50E-04
lead	no	0.015	0.003	NA	NA	NA
cadmium	no	0.005	0.005	NA	5.11E-02	5.11E-02
silver	no		0.01	NA	5.11E-01	5.11E-01
mercury	yes	0.002	0.0002	NA	6.13E-03	6.13E-03
chromium vi	no	0.1	0.01	NA	5.11E-01	5.11E-01
chromium iii	no	0.1	0.01	NA	1.02E+02	1.02E+02
barium	no	2	0.2	NA	7.15E+00	7.15E+00
arsenic	no	0.05	0.01	NA	3.07E-02	5.00E-02
antimony	no	0.006	0.06	NA	4.09E-02	6.00E-02
beryllium	no	0.004	0.005	6.65E-04	5.11E-01	5.00E-03
cyanide	no	0.2	0.01	NA	2.04E+00	2.04E+00
nickel	no	0.1	0.04	NA	2.04E+00	2.04E+00
selenium	no	0.05	0.005	NA	5.11E-01	5.11E-01
vanadium	no		0.05	NA	7.15E-01	7.15E-01
zinc	no		0.02	NA	3.07E+01	3.07E+01

NOTES: a - Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b - Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

c - Assumes TEF approach.

NA - Data not available or not applicable.

TABLE 9
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils: Carcinogenic Effects @10^{-5} (mg/Kg)	Surface Soils: Noncarcinogenic Effects (mg/Kg)	Surface Soil Criteria (mg/Kg)
naphthalene	no	0.66	NA	81,600.00	10,000.00
acenaphthylene	no	0.66	NA	NA	NA
acenaphthene	no	0.66	NA	122,400.00	10,000.00
fluorene	no	0.66	NA	81,600.00	10,000.00
phenanthrene	no	0.66	NA	NA	NA
anthracene	no	0.66	NA	612,000.00	10,000.00
fluoranthene	no	0.66	NA	16,320.00	10,000.00
pyrene	no	0.66	NA	61,200.00	10,000.00
benzo(a)anthracene	yes	0.66	79.45	NA	79.45
chrysene	yes	0.66	7,945.21	NA	7,945.21
benzo(b)fluoranthene	yes	0.66	79.45	NA	79.45
benzo(k)fluoranthene	yes	0.66	794.52	NA	794.52
benzo(a)pyrene	yes	0.66	7.94	NA	7.94
indeno(1,2,3-cd)pyrene	yes	0.66	79.45	NA	79.45
dibenzo(a,h)anthracene	yes	0.66	7.95	NA	7.95
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	128.89	NA	128.89
n-nitroso-di-n-propylamine	no	0.66	8.29	NA	8.29
bis(2-chloroisopropyl)ether	no	0.66	93.12	81,600.00	93.12
4-chloroaniline	no	1.3	NA	8,160.00	8,160.00
2-chloronaphthalene	no	0.66	NA	163,200.00	10,000.00
2,4-dinitrotoluene	no	0.66	NA	4,080.00	4,080.00
hexachlorobutadiene	yes	0.66	1.78	816.00	1.78
hexachloroethane	yes	0.66	2,898.99	408.00	408.00
isophorone	no	0.66	61,052.63	408,000.00	10,000.00
benzyl alcohol	no	1.3	NA	612,000.00	10,000.00
bis(2-chloroethyl)ether	no	0.66	4.06	NA	4.06
nitrobenzene	no	0.66	NA	1,020.00	1,020.00
1,2-dichlorobenzene	no	0.66	NA	183,600.00	10,000.00
1,3-dichlorobenzene	no	0.66	NA	NA	NA
1,4-dichlorobenzene	no	0.66	2,416.67	11,788.20	2,416.67
1,2,4-trichlorobenzene	no	0.66	NA	20,400.00	10,000.00
hexachlorobenzene	no	0.66	6.87	1,632.00	6.87
hexachlorocyclopentadiene	no	0.66	NA	2.02	2.02
n-nitrosodiphenylamine	no	0.66	11,836.73	NA	10,000.00
benzoic acid	no	3.3	NA	8,160,000.00	10,000.00
2-nitroaniline	no	3.3	NA	42.90	42.90
phenol	yes	0.66	NA	244,800.00	10,000.00
2-methylphenol	no	0.66	NA	102,000.00	10,000.00
3-methylphenol	no	0.66	NA	NA	NA
4-methylphenol	no	0.66	NA	102,000.00	10,000.00
2-chlorophenol	no	0.66	NA	10,200.00	10,000.00
2,4-dichlorophenol	no	0.66	NA	6,120.00	6,120.00
2,4,5-trichlorophenol	no	0.66	NA	204,000.00	10,000.00
2,4,6-trichlorophenol	no	0.66	1,922.89	NA	1,922.89
pentachlorophenol	no	3.3	483.33	61,200.00	483.33
2,4-dinitrophenol	no	3.3	NA	4,080.00	4,080.00
bis(2-ethylhexyl)phthalate	yes	0.66	4,142.86	8,160.00	4,142.86
butylbenzylphthalate	no	0.66	NA	408,000.00	10,000.00
di-n-butylphthalate	yes	0.66	NA	40,800.00	10,000.00
diethylphthalate	no	0.66	NA	1,632,000.00	10,000.00
di methyl phthalate	no	0.66	NA	20,400,000.00	10,000.00
di-n-octyl phthalate	no	0.66	NA	40,800.00	10,000.00

TABLE 9 (con't) REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils: Carcinogenic Effects @10^{-5} (mg/Kg)	Surface Soils: Noncarcinogenic Effects (mg/Kg)	Surface Soil Criteria (mg/Kg)
benzene	no	0.005	16.63	NA	16.63
toluene	no	0.005	NA	2,552.81	1,000.00
ethylbenzene	no	0.005	NA	7,180.32	1,000.00
xylenes	no	0.005	NA	4,080,000.00	1,000.00
vinyl chloride	no	0.01	0.02	NA	0.02
chloroethane	no	0.01	NA	2,580.36	1,000.00
1,1-dichloroethylene	no	0.005	0.15	18,360.00	0.15
1,1-dichloroethane	no	0.005	NA	973.47	973.47
1,2-dichloroethylene (cis)	no	0.005	NA	20,400.00	1,000.00
1,2-dichloroethane	no	0.005	5.27	612,000.00	5.27
trichloroethylene	no	0.005	24.97	12,240.00	24.97
1,1,1-trichloroethane	no	0.005	NA	3,998.01	1,000.00
1,1,2-trichloroethane	no	0.005	22.74	8,160.00	22.74
tetrachloroethylene	no	0.005	101.23	20,400.00	101.23
1,1,1,2-tetrachloroethane	no	0.005	75.91	61,200.00	75.91
1,1,2,2-tetrachloroethane	no	0.005	75.41	NA	75.41
chloroform	no	0.005	5.28	20,400.00	5.28
acetone	no	0.1	NA	204,000.00	1,000.00
4-methyl-2-pentanone	no	0.05	NA	102,000.00	1,000.00
methyl ethyl ketone	no	0.1	NA	6,726.27	1,000.00
Aldrin	yes	0.00268	0.27	12.24	0.27
gamma-BHC (Lindane)	yes	0.00603	44.62	122.40	44.62
chlordane	yes	0.00938	39.45	24.48	24.48
DDD	yes	0.00737	241.67	NA	241.67
DDE	yes	0.00268	170.59	NA	170.59
DDT	yes	0.00804	153.01	204.00	153.01
dieldrin	yes	0.00134	3.62	20.40	3.62
endosulfan sulfate	no	0.04422	NA	102.00	102.00
endrin	yes	0.00402	NA	122.40	122.40
heptachlor	yes	0.00201	4.16	204.00	4.16
heptachlor epoxide	no	0.05561	6.37	26.52	6.37
PCBs	yes	0.04355	7.53	NA	7.53
lead	no	0.5	NA	NA	NA
cadmium	no	0.5	NA	1,020.00	1,020.00
silver	no	1	NA	10,200.00	10,000
mercury	yes	0.1	NA	122.40	122.40
chromium vi	no	1	NA	10,200.00	10,000
chromium iii	no	1	NA	2,040,000.00	10,000
barium	no	20	NA	142,800.00	10,000
arsenic	no	1	NA	612.00	612.00
antimony	no	6	NA	816.00	816.00
beryllium	no	0.5	13.49	10,200.00	13.49
cyanide	no	0.125	NA	40,800.00	1,000.00
nickel	no	4	NA	40,800.00	10,000
selenium	no	0.5	NA	10,200.00	10,000
vanadium	no	5	NA	14,280.00	10,000
zinc	no	2	NA	612,000.00	10,000

NOTES: a -- Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b -- Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* -- Assumes TEF approach.

NA -- Data not available or not applicable.

TABLE 10

REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[1] (yes/no)	Practical Quantitation Limit[2] (mg/Kg)	Subsurface Soils: Carcinogenic Effects @10^{-5} (mg/Kg)	Subsurface Soils: Noncarcinogenic Effects (mg/Kg)	Leaching to Groundwater: Groundwater Criteria (mg/L)	Leaching to Groundwater: Subsurface Soil Criteria (mg/Kg)	Subsurface Soil Criteria (mg/Kg)
naphthalene	no	0.66	NA	58,400.00	4.09E+00	10,534.54	10,000.00
acenaphthylene	no	0.66	NA	NA	NA	NA	NA
acenaphthene	no	0.66	NA	87,600.00	6.13E+00	55,215.08	10,000.00
fluorene	no	0.66	NA	58,400.00	4.09E+00	52,850.39	10,000.00
phenanthrene	no	0.66	NA	NA	NA	NA	NA
anthracene	no	0.66	NA	438,000.00	3.07E+01	7,585,812.53	10,000.00
fluoranthene	yes	0.66	NA	11,680.00	8.18E-01	13,782.92	10,000.00
pyrene	no	0.66	NA	43,800.00	3.07E+00	140,591.20	10,000.00
benzo(a)anthracene	yes	0.66	698.63	NA	1.00E-02	103.88	103.88
chrysene	yes	0.66	69,863.01	NA	3.92E-01	67,777.62	10,000.00
benzo(b)fluoranthene	yes	0.66	698.63	NA	1.00E-02	354.98	354.98
benzo(k)fluoranthene	yes	0.66	6,986.30	NA	3.92E-02	3,759.12	3,759.12
benzo(a)pyrene	yes	0.66	69.85	NA	1.00E-02	212.87	69.85
indeno(1,2,3-cd)pyrene	yes	0.66	698.63	NA	1.00E-02	629.17	629.17
dibenzo(a,h)anthracene	yes	0.66	69.86	NA	1.00E-02	649.66	69.86
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	1,133.33	NA	2.00E-02	12.86	12.86
n-nitroso-di-n-propylamine	no	0.66	72.86	NA	1.00E-02	0.06	0.06
bis(2-chloroisopropyl)ether	no	0.66	1,472.23	58,400.00	4.09E-02	1.32	1.32
4-chloroaniline	no	1.3	NA	5,840.00	4.09E-01	1,117.69	1,117.69
2-chloronaphthalene	no	0.66	NA	116,800.00	8.18E+00	68,632.75	10,000.00
2,4-dinitrotoluene	no	0.66	NA	2,920.00	2.04E-01	39.07	39.07
hexachlorobutadiene	yes	0.66	31.18	584.00	3.67E-02	46.06	31.18
hexachloroethane	yes	0.66	29,818.48	292.00	2.04E-02	3.31	3.31
isophorone	no	0.66	536,842.11	292,000.00	3.01E+00	256.03	256.03
benzyl alcohol	no	1.3	NA	438,000.00	3.07E+01	4,356.75	4,356.75
bis(2-chloroethyl)ether	no	0.66	66.24	NA	1.00E-02	0.06	0.06
nitrobenzene	no	0.66	NA	730.00	5.11E-02	1.73	1.73
1,2-dichlorobenzene	no	0.66	NA	131,400.00	9.20E+00	15,093.56	10,000.00
1,3-dichlorobenzene	no	0.66	NA	NA	NA	NA	NA
1,4-dichlorobenzene	no	0.66	21,250.00	16,873.31	1.19E-01	34.67	34.67
1,2,4-trichlorobenzene	no	0.66	NA	14,600.00	1.02E+00	1,405.37	1,405.37
hexachlorobenzene	no	0.66	101.56	1,168.00	1.00E-02	165.57	101.56
hexachlorocyclopentadiene	no	0.66	NA	2.89	7.15E-01	3,904.08	2.89
n-nitrosodiphenylamine	no	0.66	104,081.63	NA	5.84E-01	567.80	567.80
benzoic acid	no	3.3	NA	5,840,000.00	4.09E+02	813,796.56	10,000.00
2-nitroaniline	no	3.3	NA	45.47	5.00E-02	2.08	2.08
phenol	yes	0.66	NA	175,200.00	1.23E+01	658.78	658.78
2-methylphenol	no	0.66	NA	73,000.00	5.11E+00	375.93	375.93
3-methylphenol	no	0.66	NA	NA	NA	NA	NA
4-methylphenol	no	0.66	NA	73,000.00	5.11E+00	427.24	427.24
2-chlorophenol	no	0.66	NA	7,300.00	5.11E-01	11.63	11.63
2,4-dichlorophenol	no	0.66	NA	4,380.00	3.07E-01	15.12	15.12
2,4,5-trichlorophenol	no	0.66	NA	146,000.00	1.02E+01	5,507.44	5,507.44
2,4,6-trichlorophenol	no	0.66	24,779.61	NA	2.60E-01	30.65	30.65
pentachlorophenol	no	3.3	4,250.00	43,800.00	5.00E-02	24.95	24.95
2,4-dinitrophenol	no	3.3	NA	2,920.00	2.04E-01	7.37	7.37
bis(2-ethylhexyl)phthalate	yes	0.66	36,428.57	5,840.00	2.04E-01	1,406.25	1,406.25
butylbenzylphthalate	no	0.66	NA	292,000.00	2.04E+01	421,659.24	10,000.00
di-n-butylphthalate	yes	0.66	NA	29,200.00	2.04E+00	6,188.56	6,188.56
diethylphthalate	no	0.66	NA	1,168,000.00	8.18E+01	139,039.43	10,000.00
di methyl phthalate	no	0.66	NA	14,600,000.00	1.02E+03	2,427,459.10	10,000.00
di-n-octyl phthalate	no	0.66	NA	29,200.00	2.04E+00	13,865.50	10,000.00

TABLE 10 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

REV: 11/01/93

NON-RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils: Carcinogenic Effects @10^{-5} (mg/Kg)	Subsurface Soils: Noncarcinogenic Effects (mg/Kg)	Leaching to Groundwater: Groundwater Criteria (mg/L)	Leaching to Groundwater: Subsurface Soil Criteria (mg/Kg)	Subsurface Soil Criteria (mg/Kg)
benzene	no	0.005	289.96	NA	9.86E-02	4.77	4.77
toluene	no	0.005	NA	3,631.30	2.04E+01	23,897.46	1,000.00
ethylbenzene	no	0.005	NA	9,928.27	1.02E+01	17,179.71	1,000.00
xylenes	no	0.005	NA	2,920,000.00	2.04E+02	1,232,453.05	1,000.00
vinyl chloride	no	0.01	0.30	NA	1.00E-02	0.13	0.13
chloroethane	no	0.01	NA	3,693.46	NA	NA	1,000.00
1,1-dichloroethylene	no	0.005	2.59	13,140.00	7.00E-03	0.08	0.08
1,1-dichloroethane	no	0.005	NA	1,386.78	1.02E+01	2,385.62	1,000.00
1,2-dichloroethylene (cis)	no	0.005	NA	14,600.00	1.02E+00	102.49	102.49
1,2-dichloroethane	no	0.005	91.96	438,000.00	3.14E-02	0.37	0.37
trichloroethylene	no	0.005	437.11	8,760.00	2.60E-01	25.73	25.73
1,1,1-trichloroethane	no	0.005	NA	5,600.68	9.20E+00	4,173.92	1,000.00
1,1,2-trichloroethane	no	0.005	391.20	5,840.00	5.02E-02	1.05	1.05
tetrachloroethylene	no	0.005	1,634.72	14,600.00	5.61E-02	8.01	8.01
1,1,1,2-tetrachloroethane	no	0.005	1,291.02	43,800.00	1.10E-01	7.24	7.24
1,1,2,2-tetrachloroethane	no	0.005	1,052.52	NA	1.43E-02	0.21	0.21
chloroform	no	0.005	92.76	14,600.00	4.69E-01	20.33	20.33
acetone	no	0.1	NA	146,000.00	1.02E+01	136.29	136.29
4-methyl-2-pentanone	no	0.05	NA	73,000.00	5.11E+00	407.48	407.48
methyl ethyl ketone	no	0.1	NA	9,032.18	5.11E+00	146.24	146.24
Aldrin	yes	0.00268	4.35	8.76	1.68E-04	0.06	0.06
gamma-BHC (Lindane)	yes	0.00603	392.31	87.60	2.20E-03	0.34	0.34
chlordane	yes	0.00938	368.21	17.52	2.00E-03	4.51	4.51
DDD	yes	0.00737	2,125.00	NA	1.19E-02	48.34	48.34
DDE	yes	0.00268	1,500.00	NA	8.41E-03	80.49	80.49
DDT	yes	0.00804	1,418.50	146.00	8.41E-03	141.83	141.83
dieldrin	yes	0.00134	31.87	14.60	1.79E-04	0.06	0.06
endosulfan sulfate	no	0.04422	NA	73.00	5.11E-03	12.00	12.00
endrin	yes	0.00402	NA	87.60	6.13E-03	10.12	10.12
heptachlor	yes	0.00201	55.28	146.00	6.36E-04	0.44	0.44
heptachlor epoxide	no	0.05561	56.04	18.98	8.30E-04	0.45	0.45
PCBs	yes	0.04355	66.23	NA	6.50E-04	4.23	4.23
lead	no	0.5	NA	NA	NA	NA	NA
cadmium	no	0.5	NA	730.00	5.11E-02	NA	10,000
silver	no	1	NA	7,300.00	5.11E-01	NA	10,000
mercury	yes	0.1	NA	87.60	6.13E-03	NA	87.60
chromium vi	no	1	NA	7,300.00	5.11E-01	NA	10,000
chromium iii	no	1	NA	1,460,000.00	1.02E+02	NA	10,000
barium	no	20	NA	102,200.00	7.15E+00	NA	10,000
arsenic	no	1	NA	438.00	5.00E-02	NA	10,000
antimony	no	6	NA	584.00	6.00E-02	NA	10,000
beryllium	no	0.5	118.60	7,300.00	5.00E-03	NA	118.60
cyanide	no	0.125	NA	29,200.00	2.04E+00	NA	1,000.00
nickel	no	4	NA	29,200.00	2.04E+00	NA	10,000
selenium	no	0.5	NA	7,300.00	5.11E-01	NA	10,000
vanadium	no	5	NA	10,220.00	7.15E-01	NA	10,000
zinc	no	2	NA	438,000.00	3.07E+01	NA	10,000

NOTES: a - Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b - Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

c - Assumes TEF approach.

NA - Data not available or not applicable.

TABLE 11
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

REV: 11/01/93

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater Carcinogenic Effects @10^{-6} (mg/L)	Groundwater Noncarcinogenic Effects (mg/L)	Groundwater Criteria (mg/L)
naphthalene	no		0.01	NA	1.22E+00	1.22E+00
acenaphthylene	no		0.01	NA	NA	NA
acenaphthene	no		0.01	NA	1.82E+00	1.82E+00
fluorene	no		0.01	NA	1.22E+00	1.22E+00
phenanthrene	no		0.01	NA	NA	NA
anthracene	no		0.01	NA	9.12E+00	9.12E+00
fluoranthene	yes		0.01	NA	2.43E-01	2.43E-01
pyrene	no		0.01	NA	9.12E-01	9.12E-01
benzo(a)anthracene	yes	0.0001	0.01	1.16E-04	NA	1.00E-02
chrysene	yes	0.0002	0.01	1.16E-02	NA	1.16E-02
benzo(b)fluoranthene	yes	0.0002	0.01	1.16E-04	NA	1.00E-02
benzo(k)fluoranthene	yes	0.0002	0.01	1.16E-03	NA	1.00E-02
benzo(a)pyrene	yes	0.0002	0.01	1.16E-05	NA	1.00E-02
indeno(1,2,3-cd)pyrene	yes	0.0004	0.01	1.16E-04	NA	1.00E-02
dibenzo(a,h)anthracene	yes	0.0003	0.01	1.16E-05	NA	1.00E-02
benzo(g,h,i)perylene	yes		0.01	NA	NA	NA
3,3'-dichlorobenzidine	no		0.02	1.89E-04	NA	2.00E-02
n-nitroso-di-n-propylamine	no		0.01	1.21E-05	NA	1.00E-02
bis(2-chloroisopropyl)ether	no		0.01	4.22E-04	1.22E+00	1.00E-02
4-chloroaniline	no		0.02	NA	1.22E-01	1.22E-01
2-chloronaphthalene	no		0.01	NA	2.43E+00	2.43E+00
2,4-dinitrotoluene	no		0.01	NA	6.08E-02	6.08E-02
hexachlorobutadiene	yes		0.01	1.09E-03	1.22E-02	1.00E-02
hexachloroethane	yes		0.01	5.99E-03	6.08E-03	1.00E-02
isophorone	no		0.01	8.95E-02	6.08E+00	8.95E-02
benzyl alcohol	no		0.02	NA	9.12E+00	9.12E+00
bis(2-chloroethyl)ether	no		0.01	1.63E-05	NA	1.00E-02
nitrobenzene	no		0.01	NA	1.52E-02	1.52E-02
1,2-dichlorobenzene	no	0.6	0.01	NA	2.74E+00	2.74E+00
1,3-dichlorobenzene	no	0.6	0.01	NA	NA	NA
1,4-dichlorobenzene	no	0.075	0.01	3.54E-03	1.62E+00	7.50E-02
1,2,4-trichlorobenzene	no	0.07	0.01	NA	3.04E-01	3.04E-01
hexachlorobenzene	no	0.001	0.01	5.31E-05	2.43E-02	1.00E-02
hexachlorocyclopentadiene	no	0.05	0.01	NA	2.13E-01	2.13E-01
n-nitrosodiphenylamine	no		0.01	1.73E-02	NA	1.73E-02
benzoic acid	no		0.05	NA	1.22E+02	1.22E+02
2-nitroaniline	no		0.05	NA	1.82E-03	5.00E-02
phenol	yes		0.01	NA	3.65E+00	3.65E+00
2-methylphenol	no		0.01	NA	1.52E+00	1.52E+00
3-methylphenol	no		0.01	NA	NA	NA
4-methylphenol	no		0.01	NA	1.52E+00	1.52E+00
2-chlorophenol	no		0.01	NA	1.52E-01	1.52E-01
2,4-dichlorophenol	no		0.01	NA	9.12E-02	9.12E-02
2,4,5-trichlorophenol	no		0.01	NA	3.04E+00	3.04E+00
2,4,6-trichlorophenol	no		0.01	1.75E-03	NA	1.00E-02
pentachlorophenol	no	0.001	0.05	7.08E-04	9.12E-01	5.00E-02
2,4-dinitrophenol	no		0.05	NA	6.08E-02	6.08E-02
bis(2-ethylhexyl)phthalate	yes	0.006	0.01	6.07E-03	1.22E-01	1.00E-02
butylbenzylphthalate	no	0.1	0.01	NA	6.08E+00	6.08E+00
di-n-butylphthalate	yes		0.01	NA	6.08E-01	6.08E-01
diethylphthalate	no		0.01	NA	2.43E+01	2.43E+01
di methyl phthalate	no		0.01	NA	3.04E+02	3.04E+02
di-n-octyl phthalate	no		0.01	NA	6.08E-01	6.08E-01

TABLE 11 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR GROUNDWATER

REV: 11/01/93

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	MCL or Nonzero MCLG (mg/L)	Practical Quantitation Limit[b] (mg/L)	Groundwater Carcinogenic Effects @10^{-6} (mg/L)	Groundwater Noncarcinogenic Effects (mg/L)	Groundwater Criteria (mg/L)
benzene	no	0.005	0.005	6.17E-04	NA	5.00E-03
toluene	no	1	0.005	NA	8.04E-01	1.00E+00
ethylbenzene	no	0.7	0.005	NA	1.31E+00	1.31E+00
xylenes	no	10	0.005	NA	6.08E+01	6.08E+01
vinyl chloride	no	0.002	0.01	2.81E-05	NA	1.00E-02
chloroethane	no		0.01	NA	2.32E+01	2.32E+01
1,1-dichloroethylene	no	0.007	0.005	1.67E-05	2.74E-01	7.00E-03
1,1-dichloroethane	no		0.005	NA	6.40E-01	6.40E-01
1,2-dichloroethylene (cis)	no	0.07	0.005	NA	3.04E-01	3.04E-01
1,2-dichloroethane	no	0.005	0.005	1.97E-04	9.12E+00	5.00E-03
trichloroethylene	no	0.005	0.005	1.14E-03	1.82E-01	5.00E-03
1,1,1-trichloroethane	no	0.2	0.005	NA	1.29E+00	1.29E+00
1,1,2-trichloroethane	no	0.003	0.005	3.14E-04	1.22E-01	5.00E-03
tetrachloroethylene	no	0.005	0.005	1.47E-03	3.04E-01	5.00E-03
1,1,1,2-tetrachloroethane	no		0.005	6.88E-04	9.12E-01	5.00E-03
1,1,2,2-tetrachloroethane	no		0.005	3.09E-04	NA	5.00E-03
chloroform	no	0.1	0.005	2.76E-04	3.04E-01	1.00E-01
acetone	no		0.1	NA	3.04E+00	3.04E+00
4-methyl-2-pentanone	no		0.05	NA	1.52E+00	1.52E+00
methyl ethyl ketone	no		0.1	NA	9.18E-01	9.18E-01
Aldrin	yes		0.00004	5.00E-06	1.82E-04	4.00E-05
gamma-BHC (Lindane)	yes	0.0002	0.00009	6.54E-05	1.82E-03	2.00E-04
chlordane	yes	0.002	0.00014	6.54E-05	3.65E-04	2.00E-03
DDD	yes		0.00011	3.54E-04	NA	3.54E-04
DDE	yes		0.00004	2.50E-04	NA	2.50E-04
DDT	yes		0.00012	2.50E-04	3.04E-03	2.50E-04
dieldrin	yes		0.00002	5.31E-06	3.04E-04	2.00E-05
endosulfan sulfate	no		0.00066	NA	1.52E-03	1.52E-03
endrin	yes	0.002	0.00006	NA	1.82E-03	2.00E-03
heptachlor	yes	0.0004	0.00003	1.89E-05	3.04E-03	4.00E-04
heptachlor epoxide	no	0.0002	0.00083	9.34E-06	3.95E-04	8.30E-04
PCBs	yes	0.0005	0.00065	1.10E-05	NA	6.50E-04
lead	no	0.015	0.003	NA	NA	NA
cadmium	no	0.005	0.005	NA	1.52E-02	1.52E-02
silver	no		0.01	NA	1.52E-01	1.52E-01
mercury	yes	0.002	0.0002	NA	1.82E-03	2.00E-03
chromium vi	no	0.1	0.01	NA	1.52E-01	1.52E-01
chromium iii	no	0.1	0.01	NA	3.04E+01	3.04E+01
barium	no	2	0.2	NA	2.13E+00	2.13E+00
arsenic	no	0.05	0.01	NA	9.12E-03	5.00E-02
antimony	no	0.006	0.06	NA	1.22E-02	6.00E-02
beryllium	no	0.004	0.005	1.98E-05	1.52E-01	5.00E-03
cyanide	no	0.2	0.01	NA	6.08E-01	6.08E-01
nickel	no	0.1	0.04	NA	6.08E-01	6.08E-01
selenium	no	0.05	0.005	NA	1.52E-01	1.52E-01
vanadium	no		0.05	NA	2.13E-01	2.13E-01
zinc	no		0.02	NA	9.12E+00	9.12E+00

NOTES: a - Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b - Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

c - Assumes TEF approach.

NA - Data not available or not applicable.

TABLE 12
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils: Carcinogenic Effects @10^{-6} (mg/Kg)	Surface Soils: Noncarcinogenic Effects (mg/Kg)	Surface Soil Criteria (mg/Kg)
naphthalene	no	0.66	NA	10,800.00	10,000.00
acenaphthylene	no	0.66	NA	NA	NA
acenaphthene	no	0.66	NA	16,200.00	10,000.00
fluorene	no	0.66	NA	10,800.00	10,000.00
phenanthrene	no	0.66	NA	NA	NA
anthracene	no	0.66	NA	81,000.00	10,000.00
fluoranthene	yes	0.66	NA	2,160.00	2,160.00
pyrene	no	0.66	NA	8,100.00	8,100.00
benzo(a)anthracene	yes	0.66	0.88	NA	0.88
chrysene	yes	0.66	87.67	NA	87.67
benzo(b)fluoranthene	yes	0.66	0.88	NA	0.88
benzo(k)fluoranthene	yes	0.66	8.77	NA	8.77
benzo(a)pyrene	yes	0.66	0.09	NA	0.66
indeno(1,2,3-cd)pyrene	yes	0.66	0.88	NA	0.88
dibenzo(a,h)anthracene	yes	0.66	0.09	NA	0.66
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	1.42	NA	1.42
n-nitroso-di-n-propylamine	no	0.66	0.09	NA	0.66
bis(2-chloroisopropyl)ether	no	0.66	9.14	10,800.00	9.14
4-chloroaniline	no	1.3	NA	1,080.00	1,080.00
2-chloronaphthalene	no	0.66	NA	21,600.00	10,000.00
2,4-dinitrotoluene	no	0.66	NA	540.00	540.00
hexachlorobutadiene	yes	0.66	8.21	108.00	8.21
hexachloroethane	yes	0.66	45.07	54.00	45.07
isophorone	no	0.66	673.68	54,000.00	673.68
benzyl alcohol	no	1.3	NA	81,000.00	10,000.00
bis(2-chloroethyl)ether	no	0.66	0.58	NA	0.66
nitrobenzene	no	0.66	NA	135.00	135.00
1,2-dichlorobenzene	no	0.66	NA	24,300.00	10,000.00
1,3-dichlorobenzene	no	0.66	NA	NA	NA
1,4-dichlorobenzene	no	0.66	26.67	NA	26.67
1,2,4-trichlorobenzene	no	0.66	NA	2,700.00	2,700.00
hexachlorobenzene	no	0.66	0.40	216.00	0.66
hexachlorocyclopentadiene	no	0.66	NA	1,890.00	1,890.00
n-nitrosodiphenylamine	no	0.66	130.61	NA	130.61
benzoic acid	no	3.3	NA	1,080,000.00	10,000.00
2-nitroaniline	no	3.3	NA	16.20	16.20
phenol	yes	0.66	NA	32,400.00	10,000.00
2-methylphenol	no	0.66	NA	13,500.00	10,000.00
3-methylphenol	no	0.66	NA	NA	NA
4-methylphenol	no	0.66	NA	13,500.00	10,000.00
2-chlorophenol	no	0.66	NA	1,350.00	1,350.00
2,4-dichlorophenol	no	0.66	NA	810.00	810.00
2,4,5-trichlorophenol	no	0.66	NA	27,000.00	10,000.00
2,4,6-trichlorophenol	no	0.66	58.18	NA	58.18
pentachlorophenol	no	3.3	5.33	8,100.00	5.33
2,4-dinitrophenol	no	3.3	NA	540.00	540.00
bis(2-ethylhexyl)phthalate	yes	0.66	45.71	1,080.00	45.71
butylbenzylphthalate	no	0.66	NA	54,000.00	10,000.00
di-n-butylphthalate	yes	0.66	NA	5,400.00	5,400.00
diethylphthalate	no	0.66	NA	216,000.00	10,000.00
di methyl phthalate	no	0.66	NA	2,700,000.00	10,000.00
di-n-octyl phthalate	no	0.66	NA	5,400.00	5,400.00

TABLE 12 (con't)
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SURFACE SOILS

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Surface Soils: Carcinogenic Effects @10^{-6} (mg/Kg)	Surface Soils: Noncarcinogenic Effects (mg/Kg)	Surface Soil Criteria (mg/Kg)
benzene	no	0.005	22.07	NA	22.07
toluene	no	0.005	NA	54,000.00	1,000.00
ethylbenzene	no	0.005	NA	27,000.00	1,000.00
xylenes	no	0.005	NA	540,000.00	1,000.00
vinyl chloride	no	0.01	0.34	NA	0.34
chloroethane	no	0.01	NA	NA	NA
1,1-dichloroethylene	no	0.005	1.07	2,430.00	1.07
1,1-dichloroethane	no	0.005	NA	27,000.00	1,000.00
1,2-dichloroethylene (cis)	no	0.005	NA	2,700.00	1,000.00
1,2-dichloroethane	no	0.005	7.03	81,000.00	7.03
trichloroethylene	no	0.005	58.18	1,620.00	58.18
1,1,1-trichloroethane	no	0.005	NA	24,300.00	1,000.00
1,1,2-trichloroethane	no	0.005	11.23	1,080.00	11.23
tetrachloroethylene	no	0.005	12.55	2,700.00	12.55
1,1,1,2-tetrachloroethane	no	0.005	24.62	8,100.00	24.62
1,1,2,2-tetrachloroethane	no	0.005	3.20	NA	3.20
chloroform	no	0.005	104.92	2,700.00	104.92
acetone	no	0.1	NA	27,000.00	1,000.00
4-methyl-2-pentanone	no	0.05	NA	13,500.00	1,000.00
methyl ethyl ketone	no	0.1	NA	13,500.00	1,000.00
Aldrin	yes	0.00268	0.04	1.62	0.04
gamma-BHC (Lindane)	yes	0.00603	0.49	16.20	0.49
chlordane	yes	0.00938	0.49	3.24	0.49
DDD	yes	0.00737	2.67	NA	2.67
DDE	yes	0.00268	1.88	NA	1.88
DDT	yes	0.00804	1.88	27.00	1.88
dieldrin	yes	0.00134	0.04	2.70	0.04
endosulfan sulfate	no	0.04422	NA	13.50	13.50
endrin	yes	0.00402	NA	16.20	16.20
heptachlor	yes	0.00201	0.14	27.00	0.14
heptachlor epoxide	no	0.05561	0.07	3.51	0.07
PCBs	yes	0.04355	0.08	NA	0.08
lead	no	0.5	NA	NA	NA
cadmium	no	0.5	NA	135.00	135.00
silver	no	1	NA	1,350.00	1,350.00
mercury	yes	0.1	NA	16.20	16.20
chromium vi	no	1	NA	1,350.00	1,350.00
chromium iii	no	1	NA	270,000.00	10,000
barium	no	20	NA	18,900.00	10,000
arsenic	no	1	NA	81.00	81.00
antimony	no	6	NA	108.00	108.00
beryllium	no	0.5	0.15	1,350.00	0.50
cyanide	no	0.125	NA	5,400.00	1,000.00
nickel	no	4	NA	5,400.00	5,400.00
selenium	no	0.5	NA	1,350.00	1,350.00
vanadium	no	5	NA	1,890.00	1,890.00
zinc	no	2	NA	81,000.00	10,000

NOTES: a - Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b - Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* - Assumes TEF approach.

NA - Data not available or not applicable.

TABLE 13
REV: 11/01/93

SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils		Leaching to Groundwater		
			Carcinogenic Effects @10^{-6} (mg/Kg)	Noncarcinogenic Effects (mg/Kg)	Groundwater Criteria (mg/L)	Subsurface Soil Criteria (mg/Kg)	Subsurface Soil Criteria (mg/Kg)
naphthalene	no	0.66	NA	58,400.00	1.22E+00	1,761.78	1,761.78
acenaphthylene	no	0.66	NA	NA	NA	NA	NA
acenaphthene	no	0.66	NA	87,600.00	1.82E+00	10,906.50	10,000.00
fluorene	no	0.66	NA	58,400.00	1.22E+00	8,838.64	8,838.64
phenanthrene	no	0.66	NA	NA	NA	NA	NA
anthracene	no	0.66	NA	438,000.00	9.12E+00	1,268,642.93	10,000.00
fluoranthene	yes	0.66	NA	11,680.00	2.43E-01	2,305.04	2,305.04
pyrene	no	0.66	NA	43,800.00	9.12E-01	23,512.32	10,000.00
benzo(a)anthracene	yes	0.66	698.63	NA	1.00E-02	103.88	103.88
chrysene	yes	0.66	69,863.01	NA	1.16E-02	379.27	379.27
benzo(b)fluoranthene	yes	0.66	698.63	NA	1.00E-02	354.98	354.98
benzo(k)fluoranthene	yes	0.66	6,986.30	NA	1.00E-02	501.64	501.64
benzo(a)pyrene	yes	0.66	69.85	NA	1.00E-02	212.87	69.85
indeno(1,2,3-cd)pyrene	yes	0.66	698.63	NA	1.00E-02	629.17	629.17
dibenzo(a,h)anthracene	yes	0.66	69.86	NA	1.00E-02	649.66	69.86
benzo(g,h,i)perylene	yes	0.66	NA	NA	NA	NA	NA
3,3'-dichlorobenzidine	no	1.3	1,133.33	NA	2.00E-02	12.86	12.86
n-nitroso-di-n-propylamine	no	0.66	72.86	NA	1.00E-02	0.06	0.06
bis(2-chloroisopropyl)ether	no	0.66	1,472.23	58,400.00	1.00E-02	0.17	0.17
4-chloroaniline	no	1.3	NA	5,840.00	1.22E-01	186.92	186.92
2-chloronaphthalene	no	0.66	NA	116,800.00	2.43E+00	11,478.07	10,000.00
2,4-dinitrotoluene	no	0.66	NA	2,920.00	6.08E-02	6.53	6.53
hexachlorobutadiene	yes	0.66	31.18	584.00	1.00E-02	6.78	6.78
hexachloroethane	yes	0.66	29,818.48	292.00	1.00E-02	1.15	1.15
isophorone	no	0.66	536,842.11	292,000.00	8.95E-02	1.43	1.43
benzyl alcohol	no	1.3	NA	438,000.00	9.12E+00	728.62	728.62
bis(2-chloroethyl)ether	no	0.66	66.24	NA	1.00E-02	0.06	0.06
nitrobenzene	no	0.66	NA	730.00	1.52E-02	0.29	0.29
1,2-dichlorobenzene	no	0.66	NA	131,400.00	2.74E+00	2,524.23	2,524.23
1,3-dichlorobenzene	no	0.66	NA	NA	NA	NA	NA
1,4-dichlorobenzene	no	0.66	21,250.00	16,873.31	1.00E-02	0.90	0.90
1,2,4-trichlorobenzene	no	0.66	NA	14,600.00	3.04E-01	235.03	235.03
hexachlorobenzene	no	0.66	101.56	1,168.00	1.00E-02	165.57	101.56
hexachlorocyclopentadiene	no	0.66	NA	2.89	2.13E-01	652.91	2.89
n-nitrosodiphenylamine	no	0.66	104,081.63	NA	1.73E-02	3.18	3.18
benzoic acid	no	3.3	NA	5,840,000.00	1.22E+02	136,098.44	10,000.00
2-nitroaniline	no	3.3	NA	45.47	5.00E-02	2.08	2.08
phenol	yes	0.66	NA	175,200.00	3.65E+00	110.17	110.17
2-methylphenol	no	0.66	NA	73,000.00	1.52E+00	62.87	62.87
3-methylphenol	no	0.66	NA	NA	NA	NA	NA
4-methylphenol	no	0.66	NA	73,000.00	1.52E+00	71.45	71.45
2-chlorophenol	no	0.66	NA	7,300.00	1.52E-01	1.95	1.95
2,4-dichlorophenol	no	0.66	NA	4,380.00	9.12E-02	2.53	2.53
2,4,5-trichlorophenol	no	0.66	NA	146,000.00	3.04E+00	921.06	921.06
2,4,6-trichlorophenol	no	0.66	24,779.61	NA	1.00E-02	0.25	0.25
pentachlorophenol	no	3.3	4,250.00	43,800.00	5.00E-02	24.95	24.95
2,4-dinitrophenol	no	3.3	NA	2,920.00	6.08E-02	1.23	1.23
bis(2-ethylhexyl)phthalate	yes	0.66	36,428.57	5,840.00	1.00E-02	16.43	16.43
butylbenzylphthalate	no	0.66	NA	292,000.00	6.08E+00	70,517.83	10,000.00
di-n-butylphthalate	yes	0.66	NA	29,200.00	6.08E-01	1,034.97	1,034.97
diethylphthalate	no	0.66	NA	1,168,000.00	2.43E+01	23,252.80	10,000.00
di methyl phthalate	no	0.66	NA	14,600,000.00	3.04E+02	405,965.59	10,000.00
di-n-octyl phthalate	no	0.66	NA	29,200.00	6.08E-01	2,318.85	2,318.85

TABLE 13 (con't)
SUMMARY OF HEALTH-BASED CRITERIA FOR SUBSURFACE SOILS

REV: 11/01/93

RESIDENTIAL LAND USE SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Practical Quantitation Limit[b] (mg/Kg)	Subsurface Soils: Carcinogenic Effects @10^{-6} (mg/Kg)	Subsurface Soils: Noncarcinogenic Effects (mg/Kg)	Leaching to Groundwater: Groundwater Criteria (mg/L)	Leaching to Groundwater: Subsurface Soil Criteria (mg/Kg)	Subsurface Soil Criteria (mg/Kg)
benzene	no	0.005	289.96	NA	5.00E-03	0.06	0.06
toluene	no	0.005	NA	3,631.30	8.04E-01	202.16	202.16
ethylbenzene	no	0.005	NA	9,928.27	1.31E+00	834.37	834.37
xylenes	no	0.005	NA	2,920,000.00	6.08E+01	206,114.09	1,000.00
vinyl chloride	no	0.01	0.30	NA	1.00E-02	0.13	0.13
chloroethane	no	0.01	NA	3,693.46	2.32E+01	7,788.24	1,000.00
1,1-dichloroethylene	no	0.005	2.59	13,140.00	5.00E-03	0.05	0.05
1,1-dichloroethane	no	0.005	NA	1,386.78	6.40E-01	40.07	40.07
1,2-dichloroethylene (cis)	no	0.005	NA	14,600.00	3.04E-01	17.14	17.14
1,2-dichloroethane	no	0.005	91.96	438,000.00	5.00E-03	0.02	0.02
trichloroethylene	no	0.005	437.11	8,760.00	5.00E-03	0.08	0.08
1,1,1-trichloroethane	no	0.005	NA	5,600.68	1.29E+00	229.64	229.64
1,1,2-trichloroethane	no	0.005	391.20	5,840.00	5.00E-03	0.03	0.03
tetrachloroethylene	no	0.005	1,634.72	14,600.00	5.00E-03	0.23	0.23
1,1,1,2-tetrachloroethane	no	0.005	1,291.02	43,800.00	5.00E-03	0.08	0.08
1,1,2,2-tetrachloroethane	no	0.005	1,052.52	NA	5.00E-03	0.04	0.04
chloroform	no	0.005	92.76	14,600.00	5.00E-03	0.03	0.03
acetone	no	0.1	NA	146,000.00	3.04E+00	22.79	22.79
4-methyl-2-pentanone	no	0.05	NA	73,000.00	1.52E+00	68.15	68.15
methyl ethyl ketone	no	0.1	NA	9,032.18	9.18E-01	11.62	11.62
Aldrin	yes	0.00268	4.35	8.76	4.00E-05	0.01	0.01
gamma-BHC (Lindane)	yes	0.00603	392.31	87.60	9.00E-05	0.00	0.003
chlordane	yes	0.00938	368.21	17.52	1.40E-04	0.09	0.09
DDD	yes	0.00737	2,125.00	NA	3.54E-04	0.27	0.27
DDE	yes	0.00268	1,500.00	NA	2.50E-04	0.45	0.45
DDT	yes	0.00804	1,418.50	146.00	2.50E-04	0.79	0.79
dieldrin	yes	0.00134	31.87	14.60	2.00E-05	0.00	0.003
endosulfan sulfate	no	0.04422	NA	73.00	1.52E-03	2.01	2.01
endrin	yes	0.00402	NA	87.60	1.82E-03	1.69	1.69
heptachlor	yes	0.00201	55.28	146.00	3.00E-05	0.00	0.005
heptachlor epoxide	no	0.05561	56.04	18.98	8.30E-04	0.45	0.45
PCBs	yes	0.04355	66.23	NA	6.50E-04	4.23	4.23
lead	no	0.5	NA	NA	NA	NA	NA
cadmium	no	0.5	NA	730.00	1.52E-02	NA	730.00
silver	no	1	NA	7,300.00	1.52E-01	NA	7,300.00
mercury	yes	0.1	NA	87.60	1.82E-03	NA	87.60
chromium vi	no	1	NA	7,300.00	1.52E-01	NA	7,300.00
chromium iii	no	1	NA	1,460,000.00	3.04E+01	NA	10,000.00
barium	no	20	NA	102,200.00	2.13E+00	NA	10,000.00
arsenic	no	1	NA	438.00	1.00E-02	NA	438.00
antimony	no	6	NA	584.00	6.00E-02	NA	584.00
beryllium	no	0.5	118.60	7,300.00	5.00E-03	NA	118.60
cyanide	no	0.125	NA	29,200.00	6.08E-01	NA	10,000.00
nickel	no	4	NA	29,200.00	6.08E-01	NA	10,000.00
selenium	no	0.5	NA	7,300.00	1.52E-01	NA	7,300.00
vanadium	no	5	NA	10,220.00	2.13E-01	NA	10,000.00
zinc	no	2	NA	438,000.00	9.12E+00	NA	10,000.00

NOTES: a - Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b - Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

* - Assumes TEF approach.

NA - Data not available or not applicable.

TABLE 14

REV: 11/01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE NON-RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
naphthalene	no	10,000.00	10,000.00	4.09E+00
acenaphthylene	no	NA	NA	NA
acenaphthene	no	10,000.00	10,000.00	6.13E+00
fluorene	no	10,000.00	10,000.00	4.09E+00
phenanthrene	no	NA	NA	NA
anthracene	no	10,000.00	10,000.00	3.07E+01
fluoranthene	yes	10,000.00	10,000.00	8.18E-01
pyrene	no	10,000.00	10,000.00	3.07E+00
benzo(a)anthracene	yes	79.45	103.88	1.00E-02
chrysene	yes	7,945.21	10,000.00	3.92E-01
benzo(b)fluoranthene	yes	79.45	354.98	1.00E-02
benzo(k)fluoranthene	yes	794.52	3,759.12	3.92E-02
benzo(a)pyrene	yes	7.94	69.85	1.00E-02
indeno(1,2,3-cd)pyrene	yes	79.45	629.17	1.00E-02
dibenzo(a,h)anthracene	yes	7.95	69.86	1.00E-02
benzo(g,h,i)perylene	yes	NA	NA	NA
3,3'-dichlorobenzidine	no	128.89	12.86	2.00E-02
n-nitroso-di-n-propylamine	no	8.29	0.06	1.00E-02
bis(2-chloroisopropyl)ether	no	93.12	1.32	4.09E-02
4-chloroaniline	no	8,160.00	1,117.69	4.09E-01
2-chloronaphthalene	no	10,000.00	10,000.00	8.18E+00
2,4-dinitrotoluene	no	4,080.00	39.07	2.04E-01
hexachlorobutadiene	yes	1.78	31.18	3.67E-02
hexachloroethane	yes	408.00	3.31	2.04E-02
isophorone	no	10,000.00	256.03	3.01E+00
benzyl alcohol	no	10,000.00	4,356.75	3.07E+01
bis(2-chloroethyl)ether	no	4.06	0.06	1.00E-02
nitrobenzene	no	1,020.00	1.73	5.11E-02
1,2-dichlorobenzene	no	10,000.00	10,000.00	9.20E+00
1,3-dichlorobenzene	no	NA	NA	NA
1,4-dichlorobenzene	no	2,416.67	34.67	1.19E-01
1,2,4-trichlorobenzene	no	10,000.00	1,405.37	1.02E+00
hexachlorobenzene	no	6.87	101.56	1.00E-02
hexachlorocyclopentadiene	no	2.02	2.89	7.15E-01
n-nitrosodiphenylamine	no	10,000.00	567.80	5.84E-01
benzoic acid	no	10,000.00	10,000.00	4.09E+02
2-nitroaniline	no	42.90	2.08	5.00E-02
phenol	yes	10,000.00	658.78	1.23E+01
2-methylphenol	no	10,000.00	375.93	5.11E+00
3-methylphenol	no	NA	NA	NA
4-methylphenol	no	10,000.00	427.24	5.11E+00
2-chlorophenol	no	10,000.00	11.63	5.11E-01
2,4-dichlorophenol	no	6,120.00	15.12	3.07E-01
2,4,5-trichlorophenol	no	10,000.00	5,507.44	1.02E+01
2,4,6-trichlorophenol	no	1,972.89	38.65	1.56E-01
pentachlorophenol	no	483.33	24.95	5.00E-02
2,4-dinitrophenol	no	4,080.00	7.37	2.04E-01
bis(2-ethylhexyl)phthalate	yes	4,142.86	1,406.25	2.04E-01
butylbenzylphthalate	no	10,000.00	10,000.00	2.04E+01
di-n-butylphthalate	yes	10,000.00	6,188.56	2.04E+00
diethylphthalate	no	10,000.00	10,000.00	8.18E+01
di methyl phthalate	no	10,000.00	10,000.00	1.02E+03
di-n-octyl phthalate	no	10,000.00	10,000.00	2.04E+00

TABLE 14 (con't) REV: 11/01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE NON-RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
benzene	no	16.63	4.77	9.86E-02
toluene	no	1,000.00	1,000.00	2.04E+01
ethylbenzene	no	1,000.00	1,000.00	1.02E+01
xylenes	no	1,000.00	1,000.00	2.04E+02
vinyl chloride	no	0.02	0.13	1.00E-02
chloroethane	no	1,000.00	1,000.00	NA
1,1-dichloroethylene	no	0.15	0.08	7.00E-03
1,1-dichloroethane	no	973.47	1,000.00	1.02E+01
1,2-dichloroethylene (cis)	no	1,000.00	102.49	1.02E+00
1,2-dichloroethane	no	5.27	0.37	3.14E-02
trichloroethylene	no	24.97	25.73	2.60E-01
1,1,1-trichloroethane	no	1,000.00	1,000.00	9.20E+00
1,1,2-trichloroethane	no	22.74	1.05	5.02E-02
tetrachloroethylene	no	101.23	8.01	5.61E-02
1,1,1,2-tetrachloroethane	no	75.91	7.24	1.10E-01
1,1,2,2-tetrachloroethane	no	75.41	0.21	1.43E-02
chloroform	no	5.28	20.33	4.69E-01
acetone	no	1,000.00	136.29	1.02E+01
4-methyl-2-pentanone	no	1,000.00	407.48	5.11E+00
methyl ethyl ketone	no	1,000.00	146.24	5.11E+00
Aldrin	yes	0.27	0.06	1.68E-04
gamma-BHC (Lindane)	yes	44.62	0.34	2.20E-03
chlordane	yes	24.48	4.51	2.00E-03
DDD	yes	241.67	48.34	1.19E-02
DDE	yes	170.59	80.49	8.41E-03
DDT	yes	153.01	141.83	8.41E-03
dieldrin	yes	3.62	0.06	1.79E-04
endosulfan sulfate	no	102.00	12.00	5.11E-03
endrin	yes	122.40	10.12	6.13E-03
heptachlor	yes	4.16	0.44	6.36E-04
heptachlor epoxide	no	6.37	0.45	8.30E-04
PCBs	yes	7.53	4.23	6.50E-04
lead	no	NA	NA	NA
cadmium	no	1,020.00	10,000.00	5.11E-02
silver	no	10,000.00	10,000.00	5.11E-01
mercury	yes	122.40	87.60	6.13E-03
chromium vi	no	10,000.00	10,000.00	5.11E-01
chromium iii	no	10,000.00	10,000.00	1.02E+02
barium	no	10,000.00	10,000.00	7.15E+00
arsenic	no	612.00	10,000.00	5.00E-02
antimony	no	816.00	10,000.00	6.00E-02
beryllium	no	13.49	118.60	5.00E-03
cyanide	no	1,000.00	1,000.00	2.04E+00
nickel	no	10,000.00	10,000.00	2.04E+00
selenium	no	10,000.00	10,000.00	5.11E-01
vanadium	no	10,000.00	10,000.00	7.15E-01
zinc	no	10,000.00	10,000.00	3.07E+01

NOTES: a - Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b - Practical quantitation limits based EPA SW-846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

c - Assumes TEF approach.

NA - Data not available or not applicable.

TABLE 15
REV: 1 /01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
naphthalene	no	10,000.00	1,761.78	1.22E+00
acenaphthylene	no	NA	NA	NA
acenaphthene	no	10,000.00	10,000.00	1.82E+00
fluorene	no	10,000.00	8,838.64	1.22E+00
phenanthrene	no	NA	NA	NA
anthracene	no	10,000.00	10,000.00	9.12E+00
fluoranthene	yes	2,160.00	2,305.04	2.43E-01
pyrene	no	8,100.00	10,000.00	9.12E-01
benzo(a)anthracene	yes	0.88	103.88	1.00E-02
chrysene	yes	87.67	379.27	1.16E-02
benzo(b)fluoranthene	yes	0.88	354.98	1.00E-02
benzo(k)fluoranthene	yes	8.77	501.64	1.00E-02
benzo(a)pyrene	yes	0.66	69.85	1.00E-02
indeno(1,2,3-cd)pyrene	yes	0.88	629.17	1.00E-02
dibenzo(a,h)anthracene	yes	0.66	69.86	1.00E-02
benzo(g,h,i)perylene	yes	NA	NA	NA
3,3'-dichlorobenzidine	no	1.42	12.86	2.00E-02
n-nitroso-di-n-propylamine	no	0.66	0.06	1.00E-02
bis(2-chloroisopropyl)ether	no	9.14	0.17	1.00E-02
4-chloroaniline	no	1,080.00	186.92	1.22E-01
2-chloronaphthalene	no	10,000.00	10,000.00	2.43E+00
2,4-dinitrotoluene	no	540.00	6.53	6.08E-02
hexachlorobutadiene	yes	8.21	6.78	1.00E-02
hexachloroethane	yes	45.07	1.15	1.00E-02
isophorone	no	673.68	1.43	8.95E-02
benzyl alcohol	no	10,000.00	728.62	9.12E+00
bis(2-chloroethyl)ether	no	0.66	0.06	1.00E-02
nitrobenzene	no	135.00	0.29	1.52E-02
1,2-dichlorobenzene	no	10,000.00	2,524.23	2.74E+00
1,3-dichlorobenzene	no	NA	NA	NA
1,4-dichlorobenzene	no	26.67	0.90	7.50E-02
1,2,4-trichlorobenzene	no	2,700.00	235.03	3.04E-01
hexachlorobenzene	no	0.66	101.56	1.00E-02
hexachlorocyclopentadiene	no	1,890.00	2.89	2.13E-01
n-nitrosodiphenylamine	no	130.61	3.18	1.73E-02
benzoic acid	no	10,000.00	10,000.00	1.22E+02
2-nitroaniline	no	16.20	2.08	5.00E-02
phenol	yes	10,000.00	110.17	3.65E+00
2-methylphenol	no	10,000.00	62.87	1.52E+00
3-methylphenol	no	NA	NA	NA
4-methylphenol	no	10,000.00	71.45	1.52E+00
2-chlorophenol	no	1,350.00	1.95	1.52E-01
2,4-dichlorophenol	no	810.00	2.53	9.12E-02
2,4,5-trichlorophenol	no	10,000.00	921.06	3.04E+00
2,4,6-trichlorophenol	no	58.18	0.25	1.00E-02
pentachlorophenol	no	5.33	24.95	5.00E-02
2,4-dinitrophenol	no	540.00	1.23	6.08E-02
bis(2-ethylhexyl)phthalate	yes	45.71	16.43	1.00E-02
butylbenzylphthalate	no	10,000.00	10,000.00	6.08E+00
di-n-butylphthalate	yes	5,400.00	1,034.97	6.08E-01
diethylphthalate	no	10,000.00	10,000.00	2.43E+01
dimethyl phthalate	no	10,000.00	10,000.00	3.04E+02
di-n-octyl phthalate	no	5,400.00	2,318.85	6.08E-01

TABLE 15 (con't) REV: 1 /01/93

SUMMARY OF TIER II CLEANUP GOALS FOR THE RESIDENTIAL SCENARIO

Chemical Name	Compound is Bioaccumulatable[a] (yes/no)	Surface Soils (mg/Kg)	Subsurface Soils (mg/Kg)	Groundwater (mg/L)
benzene	no	22.07	0.06	5.00E−03
toluene	no	1,000.00	202.16	1.00E+00
ethylbenzene	no	1,000.00	834.37	1.31E+00
xylenes	no	1,000.00	1,000.00	6.08E+01
vinyl chloride	no	0.34	0.13	1.00E−02
chloroethane	no	NA	1,000.00	2.32E+01
1,1−dichloroethylene	no	1.07	0.05	7.00E−03
1,1−dichloroethane	no	1,000.00	40.07	6.40E−01
1,2−dichloroethylene (cis)	no	1,000.00	17.14	3.04E−01
1,2−dichloroethane	no	7.03	0.02	5.00E−03
trichloroethylene	no	58.18	0.08	5.00E−03
1,1,1−trichloroethane	no	1,000.00	229.64	1.29E+00
1,1,2−trichloroethane	no	11.23	0.03	5.00E−03
tetrachloroethylene	no	12.55	0.23	5.00E−03
1,1,1,2−tetrachloroethane	no	24.62	0.08	5.00E−03
1,1,2,2−tetrachloroethane	no	3.20	0.04	5.00E−03
chloroform	no	104.92	0.03	1.00E−01
acetone	no	1,000.00	22.79	3.04E+00
4−methyl−2−pentanone	no	1,000.00	68.15	1.52E+00
methyl ethyl ketone	no	1,000.00	11.62	9.18E−01
Aldrin	yes	0.04	0.01	4.00E−05
gamma−BHC (Lindane)	yes	0.49	0.003	2.00E−04
chlordane	yes	0.49	0.09	2.00E−03
DDD	yes	2.67	0.27	3.54E−04
DDE	yes	1.88	0.45	2.50E−04
DDT	yes	1.88	0.79	2.50E−04
dieldrin	yes	0.04	0.003	2.00E−05
endosulfan sulfate	no	13.50	2.01	1.52E−03
endrin	yes	16.20	1.69	2.00E−03
heptachlor	yes	0.14	0.005	4.00E−04
heptachlor epoxide	no	0.07	0.45	8.30E−04
PCBs	yes	0.08	4.23	6.50E−04
lead	no	NA	NA	NA
cadmium	no	135.00	730.00	1.52E−02
silver	no	1,350.00	7,300.00	1.52E−01
mercury	yes	16.20	87.60	2.00E−03
chromium vi	no	1,350.00	7,300.00	1.52E−01
chromium iii	no	10,000.00	10,000.00	3.04E+01
barium	no	10,000.00	10,000.00	2.13E+00
arsenic	no	81.00	438.00	5.00E−02
antimony	no	108.00	584.00	6.00E−02
beryllium	no	0.50	118.60	5.00E−03
cyanide	no	1,000.00	10,000.00	6.08E−01
nickel	no	5,400.00	10,000.00	6.08E−01
selenium	no	1,350.00	7,300.00	1.52E−01
vanadium	no	1,890.00	10,000.00	2.13E−01
zinc	no	10,000.00	10,000.00	9.12E+00

NOTES: a − Compounds that are assumed to be bioaccumulative have an acceptable hazard index of 0.2 versus 1, as determined based on Indiana Register, 16:7, April 1, 1993.

b − Practical quantitation limits based EPA SW−846, 1986 for GC/MS. PQLs will change according to the specific analytical method used.

c − Assumes TEF approach.

NA − Data not available or not applicable.